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THIRTY-SIXTH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

BOARD OF AGRICULTURE,

WITH

RETURNS OF THE FINANCES OF THE AGRICULTURAL SOCIETIES,

FOR

1888.

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STATE BOARD OF AGRICULTURE, 1889.

Members ex officiis.

His Excellency OLIVER AMES.
His Honor J. Q. A. BRACKETT.
Hon. HENRY B. PEIRCE, *Secretary of the Commonwealth.*
H. H. GOODELL, *President Massachusetts Agricultural College.*

Appointed by the Governor and Council.

	Term Expires.
JAMES S. GRINNELL of Greenfield,	1890
GEORGE B. LORING of Salem,	1891
JAMES W. STOCKWELL of Sutton,	1892

Chosen by the Incorporated Societies.

Amesbury and Salisbury,	WM. H. B. CURRIER of Amesbury,	1891
Bay State,	EDWARD BURNETT of Southborough,	1890
Barnstable,	NATHAN EDSON of Barnstable,	1892
Berkshire,	ALONZO BRADLEY of Lee,	1891
Blackstone Valley,	VELOROUS TAFT of West Upton,	1891
Bristol,	AVERY P. SLADE of Somerset,	1890
Deerfield Valley,	F. G. HOWES of Ashfield,	1890
Eastern Hampden,	WM. HOLBROOK of Palmer,	1891
Essex,	BENJAMIN P. WARE of Marblehead (P. O. Clifton),	1890
Franklin,	J. C. NEWHALL of Conway,	1892
Hampden,	GEO. S. TAYLOR of Chicopee Falls,	1891
Hampshire,	D. A. HORTON of Northampton,	1892
Hampshire, Franklin & Hampden,	F. K. SHELDON of Southampton,	1891
Highland,	W. H. SNOW of Becket,	1890
Hingham,	EDMUND HERSEY of Hingham,	1891
Hoosac Valley,	S. A. HICKOX of South Williamstown,	1891
Housatonic,	J. H. ROWLEY of South Egremont (P. O. Great Barrington),	1891
Hillside,	S. W. CLARK of Plainfield (P. O. Cummington),	1890
Marshfield,	GEO. J. PETERSON of Marshfield (P. O. Green Harbor),	1891
Martha's Vineyard,	N. S. SHALER of Cambridge,	1892
Massachusetts,	E. F. BOWDITCH of Framingham,	1891
Massachusetts Horticultural,	E. W. WOOD of West Newton,	1891
Middlesex,	W. W. RAWSON of Arlington,	1891
Middlesex North,	A. C. VARNUM of Lowell,	1892
Middlesex South,	S. B. BIRD of Framingham,	1890
Nantucket,	CHAS. W. GARDNER of Nantucket,	1891
Oxford,	D. M. HOWE of Charlton (P. O. Oxford),	1892
Plymouth,	ELBRIDGE CUSHMAN of Lakeville,	1890
Spencer,	J. G. AVERY of Spencer,	1892
Union,	C. B. HAYDEN of Blandford,	1892
Worcester,	C. L. HARTSHORN of Worcester,	1890
Worcester North,	GEO. CRUICKSHANKS of Fitchburg,	1890
Worcester North-west,	J. P. LYNDE of Athol,	1892
Worcester South,	G. L. CLEMENCE of Southbridge,	1892
Worcester West,	J. HENRY GODDARD of Barre,	1890

CHARLES A. GOESSMANN, Ph.D., Amherst, *Chemist to the Board.*
CHARLES H. FERNALD, Ph.D., Amherst, *Entomologist to the Board.*

WILLIAM R. SESSIONS,
Secretary.

THE THIRTY-SIXTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The work of the Board of Agriculture the past year has been along the usual lines of effort. Most of the members have exhibited a marked interest in their duties. Some of them have spent much valuable time, for which they receive no compensation. The delegates to the several fairs have in almost every instance attended to the duty assigned them; making detailed reports to the Board of the work of the several societies as well as of their annual exhibitions. One hundred and twenty-five farmers' institutes have been held the past year under the auspices of the several incorporated agricultural societies. Most of these have been attended by at least one member of the Board. The member attending has usually presented a lecture upon the subject which the institute was called to consider. These meetings are growing in interest, and are believed to be doing a good work in spreading information and in encouraging the agriculturists of the State to attempt those branches of farming which promise the surest returns for the investment of capital and the employment of labor. The three days' public meeting of the Board, held at Easthampton, December 4, 5 and 6, was planned for work in the same direction. Most of the lectures were short, and dealt with specific branches of

farming. They were by successful men of practical experience in the specialties which they treated. Each lecture was followed by spirited discussions participated in by members of the Board and by the farmers present from all parts of the State. Valuable experience and information upon each topic was the result. The evening lectures were planned for the entertainment and instruction of the people of the village of Easthampton. The subjects presented on the third day were of special interest to the Patrons of Husbandry, who, appreciating the compliment paid them, gave us the largest audience of the session. The three days' meeting was a success. Those who found it convenient to be present enjoyed and profited by it, but they have not a monopoly of its benefit. The lectures and discussions will be found printed with this report in the Agriculture of Massachusetts for 1888, which the liberality of the Legislature enables us to distribute through the State. Thus these valuable papers will be placed within the reach of those for whose benefit they were prepared.

Four essays prepared by members of the Board, and read at the annual meeting in Boston, are also printed in this volume. By direction of the Board, the laws of the State pertaining to the Board of Agriculture and the several incorporated agricultural societies, together with the rules and requirements of the Board, are printed in the Appendix, where may also be found the report of the Cattle Commissioners and the report of the Board of Control of the State Experiment Station.

The following table will show the distribution of the last edition of the report. Of the 15,000 copies authorized to be printed, 7,578 are distributed by law as follows: —

Executive Department,	14
Senators,	1,000
Representatives,	6,000
Clerks of the two Houses,	52
Reporters,	12
Bound with Public Documents,	500
	7,578

The balance are under the control of the secretary, and were distributed as follows: —

Members of Board of Agriculture,	500
Incorporated agricultural societies,	1,650
Farmers' clubs,	1,484
Granges,	2,394
General distribution,	990
On hand and unaccounted for,	404
	7,422

Distribution by States and Territories.

Maine 25, New Hampshire 9, Vermont 8, Massachusetts 14,407, Rhode Island 6, Connecticut 25, New York 9, New Jersey 3, Pennsylvania 11, Delaware 1, Maryland 7, Virginia 2, North Carolina 1, Georgia 12, Florida 1, Louisiana 1, Texas 1, Ohio 1, Indiana 3, Illinois 4, Michigan 14, Missouri 4, Iowa 2, Kansas 2, Nebraska 2, Tennessee 1, Minnesota 1, Wisconsin 2, Oregon 1, Dakota 1, Utah 1, Colorado 3, California 1, District of Columbia 1.

Distribution to Foreign Countries.

Canada 7, New Brunswick 2, Nova Scotia 1, Brazil 1, England 2, Scotland 1, France 1, Italy 1, Austria 2, India 1, Japan 2, Australia 2.

During the past year two new agricultural societies have been incorporated — one at Spencer, the other at Oxford, both in Worcester County. Each has started with remarkable vigor and enthusiasm, taking a position quite abreast of the most aggressive and successful of the older societies. There are now thirty-five societies represented on the Board of Agriculture.

The Legislature of 1888 appropriated one thousand dollars "for the dissemination of useful information in agriculture." From this fund has been paid the cost of the crop reports issued from this office for the months of June, July, August, September and October. The expense of printing the valuable paper on Tuberculosis by Dr. C. H. Fernald of the Agricultural College, distributed by the Hatch Experiment Station, was also paid from this appropriation. From the same fund has been paid the expense of more than twenty lectures that were delivered by prominent agriculturists at farmers' institutes. Much more might have been ac-

complished had the appropriation been available earlier in the season. The crop reports referred to above were an experiment. The labor required to collect and arrange this information was very considerable. The sixty farmers' clubs and ninety granges scattered all over the State were each requested to appoint a correspondent whose duty should be to report monthly, answering questions propounded by means of a printed circular issued from this office. Most of these organizations responded promptly with the information desired, while others neglected to do it on time or ignored it altogether. Complete returns from each one would enable us to make our work more reliable, and more valuable to the farmers for whose benefit it is undertaken. This experiment met with an appreciative reception. The demand for the reports increased from month to month until an edition of 1,000 copies was required for the October number. It is intended to resume this work on the opening of spring.

The secretary of the Board of Agriculture is *ex officio* a trustee of the Massachusetts Agricultural College. As such his duties at the college have been many and exacting during the past year. In the absence of a regular professor of agriculture the management of the college farm has devolved upon the president of the college. His hands have been more than full, and he has properly called on the members of the Board of Trustees to assist him in this unusual duty. Naturally the larger share of this work has fallen upon the secretary. The starting of the College Experiment Station with funds appropriated by the United States Congress has also taxed the time and energies of the president and trustees, thus increasing largely the demands upon the time and strength of the occupant of this office. The trustees of the college also insisted upon making the secretary of the Board of Agriculture secretary of their board, so that the records might be kept in this office, where they would be easy of access to the interested public and the trustees. It will also be remembered that the Legislature of 1888 enlarged the Board of Control of the Massachusetts Experiment Station by adding the director of the station, one member to be chosen by the Massachusetts State Grange, one member to

be chosen by the Massachusetts Horticultural Society, and the secretary of the Board of Agriculture. In the reorganization of the Board of Control, after this addition to their number, the last-named member was chosen their secretary. Thus have been brought together in this office the records of the three State boards that have in charge the agricultural interests of the State. This action seems suitable on account of convenience of doing the business of these boards, but it has resulted in very largely increasing the work of the office.

It may not be out of place to refer in this connection to the new department of vegetable physiology that has been established at the Massachusetts Experiment Station. It is devoted to the investigation of the diseases of plants. The work accomplished in that direction is expected to be especially valuable to the horticulturists and market gardeners of the State. The large increase in the products of those engaged in these special departments of agriculture justify this enterprise. The value of the vegetables produced in this State, as shown by the census of 1885, was $5,227,194 against $1,824,112 in 1845. This increase has been largely in the finer vegetables. The last census shows of asparagus $100,000; of celery $154,000; of green corn $239,000; of lettuce $109,000; of tomatoes $164,000; of dandelions $55,000; and many thousands more for other delicacies in the form of vegetables which were not produced for market until within a few years. The sale of flowers is enormous in comparison with the amount a few years ago. From the best information obtainable we estimate the sales in Boston alone at not less than $500,000 the past year.

It is the duty of the secretary of this Board to visit the incorporated agricultural societies at fairs and institutes as often as the other duties of his office will allow. In fulfilling his duty he has attended thirteen fairs where it was expected that the secretary would at least extend the greeting of the Board, and he has spoken at twenty-three farmers' meetings or institutes during the year 1888. It is properly expected that this department shall be interested in all matters relating to agriculture which come before the committees of the Legislature. In this line of duty the secretary has attended several hearings before legislative committees. Invitations

to attend agricultural conventions and important agricultural meetings in neighboring States are constantly pressed upon the Massachusetts secretary. These courtesies cannot always be ignored, and meetings in New Hampshire, Vermont, Rhode Island and Connecticut have been attended during the year past. We have received a return in kind from the secretaries of these States, gaining for the discussions at our public meetings the knowledge and experience of the officers of the State boards of these neighboring States.

The books in our office have been arranged in convenient order for consultation, a reference catalogue of subjects prepared, and about 300 new volumes added to the library, which now numbers about 1,550 volumes.

We have endeavored to make a complete directory of the granges, farmers' clubs and other agricultural organizations in the State, showing the names, location, number of members, number of meetings held the past year and names and addresses of their officers. There are at present in the State 60 farmers' clubs with an active membership of 3,700, and 97 granges with a membership of about 6,300. These farmers' clubs held 618 meetings and the granges about 2,350 meetings during the past year. Circulars have been sent to every town in the State, in the efforts to gain this information. Prompt replies have usually been received, but in some cases no response has been made. The same is true of circulars sent out to county officials for information in regard to the workings of the dog law and the damage to domestic animals. The following table, though incomplete, will be of interest to those who have given the matter attention: —

Number of Dogs licensed, Amount received for Licenses, Damages to Domestic Animals, etc., in 1888.

COUNTY.	Number of Dogs licensed.	Amount received for Licenses.	Amount awarded for Damages and appraising Damages.	Number of Sheep killed.	Number of Sheep injured.	Number of Fowls killed.	Number of Cattle killed and injured.	Number of other Domestic Animals killed and injured.
Barnstable,	1,483	$2,932 20	$378 10	42	7	144	1	4
Berkshire,	3,818	7,290 40	4,921 39	*	*	*	*	*
Bristol,	7,602	15,898 80	3,077 10	45†	–	2,353	4	15
Dukes,	197	403 00	68 20	16	13	–	–	–
Essex,	12,701	25,826 80	4,215 53	80	78	1,746	–	37
Franklin,	1,936	3,890 40	2,109 25	351†	–	–	–	53
Hampden,	4,656	10,816 00	2,140 70	221	63	327	6	9
Hampshire,	2,614	5,293 20	1,604 83	190	102	43	17	20
Middlesex,	18,262	38,492 40	2,277 25	111	27	602	10	3
Nantucket,	146	349 00	31 20	3	–	16	–	–
Norfolk,	7,444	15,663 00	1,389 50	2	–	916	9	6
Plymouth,	5,991	12,566 05	2,282 43	47	20	892	6	31
Suffolk,	11,613	26,187 00	761 34	33	79	550	–	1
Worcester,	12,034	25,384 80	5,280 04	400	102	403	24	5
	90,497	$190,993 05	$30,536 86	–	–	–	–	–

* No returns received.

† Includes both killed and injured.

There seems no immediate prospect of a material increase in the sheep-keeping industry of the State. It is a paying business, and there are thousands of acres of pasture-land lying too remote from farm buildings to be profitably grazed by dairy cows. These acres might support very large flocks of sheep. These flocks would bring substantial income to their owners and would save these waste places from again becoming forest land after so many years of occupancy by flocks and herds. The dog is the "lion in the way." While we believe that the more flocks of sheep there are the less likely are they to be disturbed by dogs, and that farmers owe it to themselves and the community to utilize these back pastures, we cannot wonder that they shrink from the probable "slaughter of the innocents." When dogs run at large in company, the old wolf instinct seems to get the ascendency, and they are ready for work that would almost shame their savage ancestors.

There is no such sentimental objection to the dairy business. It has been rapidly increasing for several years past. The census of 1870 gave as the product of butter for Massachusetts 6,559,161 pounds; in 1875, 7,922,431 pounds were produced; in 1880, 9,655,587 pounds; in 1885, 9,685,539 pounds were made on farms. But between 1880 and 1885 the co-operative creamery made its appearance, and more than sufficient butter was manufactured by these establishments to keep up the ratio of increase. Statistics gathered by us show that there are at present 24 co-operative creameries in operation in the State, besides 2 co-operative milk associations that use their surplus milk in butter making. These 26 establishments produced at least 2,000,000 pounds of creamery butter in 1888, which was sold at an average price of 28 cents per pound at wholesale. To produce this butter the cream from the milk of about 11,000 cows was used. The cost of gathering the cream, making and marketing the butter and managing the business, averaged $5\frac{1}{4}$ cents per pound, making it net to the farmer $22\frac{3}{4}$ cents per pound, leaving the skim milk on the farms, to be used in feeding calves and pigs. It will be noticed that this method of dairying removes from the farm all the labor of butter-making except cleansing the milk pails and cans. In

addition to the above, C. Brigham & Co., of Boston, made from their surplus milk in 1888 about 500,000 pounds of butter; also, O. S. French & Co., of Boston, made about 44,200 pounds of butter from their surplus milk during the same period.

There seems to be no obstacle to the indefinite increase of this industry in our State except the unfair competition of oleomargarine, of which the milk inspector of Boston tells us there were sold by Boston wholesale dealers alone 5,420,000 pounds in 1888. When we consider that many dealers outside of Boston receive their supplies direct from Chicago, we may realize in some measure the competition to which honest butter is subjected in our markets. If this commodity was preferred to butter by the consumers, and was sold at the low price at which it can be afforded, we might feel that the people of the State were profiting by the competition; but the inspector of the Board of Health testified before a committee of our Legislature that he believed that most of it was eaten by people who supposed it to be honest butter, and that the average price at which it was retailed was not less than 25 cents per pound.

The increase in the number of our neat stock is quite suggestive. The census of 1885 reported 162,847 milch cows and 57,044 of other neat stock. These numbers were somewhat less than the assessors' returns for the same year. We have no census since 1885, but the aggregates of polls, property, etc., for 1888, show 187,994 milch cows and 65,609 of other neat stock. The consumption of milk is also rapidly increasing. The statistics of the Boston milk trade show that 1,689,311 gallons more milk were sold in that city in 1888 than in 1886. There is no doubt that in other parts of the State there has been the same ratio of increase.

The past season has not been as favorable for farming operations as that of a year ago. Spring opened late. May was a month with few pleasant days, but the weather suited the grass crop; both meadows and pastures were unusually promising. June gave us a still larger rainfall than May, and hoed crops were backward and those on low ground suffered materially. July had less rain, and the hay crop was generally secured seasonably and in good condition.

The crop was large and of good quality. But the cool weather of the month was still unfavorable for cultivated crops. Corn was particularly backward. August was also cool, keeping corn back but giving good feed in pastures. September bore off the palm for rain; 10.70 inches of rainfall were recorded by the gauge at the Amherst Experiment Station. A killing frost occurred over nearly the entire State on the 6th and 7th, seriously injuring the unripe corn and some other crops, particularly cranberries. October was also a wet, cold month, with 5.19 inches of rainfall and very few days of sunshine. Many fields of corn which were injured by the frosts of September were completely ruined by wet weather after stooking. The unprecedented amount of bad weather throughout the entire season not only injured quantity and quality of money crops, but made it impossible to do much farm work seasonably. Our corn crop, both grain and stover, was not much more than two-thirds the usual amount. Rye, oats and hay were above the average. Potatoes were a good crop in quantity, but the quality was below the average. Some sections suffered severely from rot. Onions and cabbage were much above the average, and the market was thereby over-stocked, so that prices were not sustained; and many farmers find themselves at this date with a large surplus on hand which the market will not take at paying prices. Cranberries were much injured by the early frosts. The final yield was not more than 75 per cent of the crop of a year ago. Small fruits and market-garden crops were quite as good as usual. A very large crop of apples was secured, but the quality was not up to the average. Prices have ruled low, and at this time hundreds of barrels are in the growers' hands with no demand from the trade for them. Prices of milk and butter have been fairly sustained. On the whole, we must count the year 1888 as not a particularly successful one for Massachusetts agriculturists.

In order to give an idea of the peculiar meteorological phenomena of the past year, we include a table prepared and kindly furnished by the director of the State Agricultural Experiment Station at Amherst.

War Department, Signal Service.

Annual Summary of Meteorological Observations, made by the Massachusetts State Agricultural Experiment Station, Voluntary Observer at Amherst, for the year ending Dec. 31, 1888.

Month.	Mean humidity.	Temperature.			Total precipitation (rain and melted snow), inches.	Total snowfall, inches.	Wind.		Remarks.
		Mean.	Max.	Min.			Prevailing direction.	Maximum velocity or force.	
1888.									
January,	–	13.78	41 0	–21.5	3.87	19.0	N. W.	5	The last killing frost occurred May 8; the first, Sept. 7. The last snow-storm occurred April 10; the first, Nov. 25.
February,	–	22.05	46.0	–19.0	3.94	9.5	N. W.	5	
March,	–	26 82	49.0	– 3.0	5.96	20.0	N. W.	6	
April,	–	40 41	84.0	15.0	3.08	1.5	N. W.	4	
May,	74.39	54.70	80.0	26 0	4.29	–	S. W.	4	
June,	73.18	65.82	94.5	38.0	5.40	–	N. W.	4	
July,	71.69	67.20	85.5	46.0	3.63	–	N. W.	4	
August,	76.66	67.38	87.0	42 0	4.29	–	N. W.	4	
September,	80.89	57.10	76 0	25.0	10.70	–	N. W.	4	
October,	78.12	43.12	66.0	26.0	5.19	–	N. W.	4	
November,	–	38 93	71.0	5.7	3.91	5.00	N. E.	4	
December,	–	30.40	56.5	3.5	3.78	2.75	N. W.	4	
Sums,	454.93	527.74	836.50	183.7	58.04	57.75	–	–	
Averages,	76.82	43.98	69.71	15.31	4.84	–	–	–	

Certified to as a correct copy of the duplicate records in my possession.

C. A. GOESSMANN.

While we are unable to encourage our people by statistics of unusual prosperity, we must put on record our unqualified belief that agriculture, carried on with energy, industry, enterprise and good judgment, will, in the long run, be as successful in Massachusetts as in any other part of the Union. Some of the counties in our State produce nearly or quite as large an aggregate value of agricultural products as any county in the country, while the wonderful production of manufactured articles by these same counties makes us proud of our State and people. The capacity of our State for increase in agricultural products is enormous. We have besides the woodland 1,569,667 acres of uncultivated land. The cultivated land, 939,260 acres, which includes the mowing lands, according to the census of 1885, produced $47,756,033 worth of agricultural products. The average product per acre of the cultivated land was only about $50, while we have one town in the State that produced $218 worth of agricultural products per cultivated acre. Our uncultivated acres are capable of producing good returns if put to proper uses. We believe that our State would be more powerful and better able to withstand commercial depression, political upheaval or class dissatisfaction, with a large and prosperous rural population, and that the greatest good to the greatest number in our State will lead our Legislature to foster and encourage the agriculture of the State. Mindful of past liberality, the farmers of the State are sanguine that those of other callings in this our grand old Commonwealth, will still remember to do justice to those of us engaged in the foundation industry.

WILLIAM R. SESSIONS,
Secretary of the State Board of Agriculture.

BOSTON, February, 1889.

PUBLIC MEETING OF THE BOARD

AT

EASTHAMPTON.

PUBLIC MEETING OF THE BOARD
AT EASTHAMPTON.

The Country Meeting of the Massachusetts Board of Agriculture was held in the Town Hall at Easthampton, on Tuesday, Wednesday and Thursday, Dec. 4, 5 and 6, 1888. Hon. George B. Loring presided, and called the meeting to order, after which the Rev. Mr. Colton offered prayer. The Rev. Dr. S. T. Seelye of Easthampton then delivered the opening address, as follows: —

OPENING ADDRESS.

BY S. T. SEELYE, D.D., OF EASTHAMPTON.

Mr. Chairman and Gentlemen of the State Board of Agriculture.

The pleasant duty has been assigned me of extending to you a most cordial welcome, in behalf of the Hampshire, Franklin and Hampden Agricultural Society, the Farmers' Club, and the citizens of Easthampton. We are glad to see you. We deem it no small honor to be visited by this Board of representative men, who have made the great interests of agriculture the study and the business of their lives. We highly appreciate the opportunity thus afforded us of adding to our scanty stores by sharing the rich treasures which you have gathered by years of careful investigation and unremitting toil. We shall listen with earnest attention to your words of wisdom, and we are sure that our mental horizon will be broadened and our aspirations will be uplifted by your coming. But the rich blessing which you are to give us compels us to ask, What can we do for you? We would not only receive, — we would also give. Yet, in the things where you are so rich, we are poor indeed. We could only repay you in copper, where

you give us gold. We have no fancy farms, we originate no new methods of tillage, we raise very little long-pedigree stock. This, however, means no disparagement to our farmers. In all those noble qualities which give dignity and worth to manhood, they stand in the front rank. They are intelligent, industrious, upright, loyal, true men — true as steel. In spite of the thin, leachy soil, whose craving for fertilizers can never be appeased, these farmers are forehanded, live in good homes, and give a good education to their children; and this is a sufficient proof of their perseverance and skill. But in all agricultural matters we can teach you nothing — we can only sit at your feet. Is there nothing, then, that we can do for you? In this valley of the Connecticut we could show you many a scene of beauty, which it would immortalize an artist to portray upon the canvas. From the summit of Tom or Holyoke you could look down upon a landscape which for quiet, enchanting loveliness is without a rival. It does not, however, satisfy us merely to show you this natural scenery, beautiful and charming as it is; for we have something better, and we wish to give you the very best. Here in Easthampton we can give you the clearest possible proof of the mighty and beneficent power of an earnest, unselfish life; for here we can see what it has wrought, and we can feel its constant and blessed influence upon ourselves. These fine churches, these great factories, this richly endowed seminary, this memorial hall and the public library, are the visible achievements of such a life; while the generous impulse which makes the heart warm with sympathy and opens the hand to help the needy, and the spirit which makes us loyal to town and State and country, are the unseen proofs of its abiding presence. To make this perfectly clear, let me give you the briefest possible sketch of the character and work of two men who have blessed this town beyond measure, by living not for themselves but for the world.

Samuel Williston showed what was to be the purpose of his life, when in early youth he devoted himself to the work of the ministry. Though he was turned aside from his chosen profession, that purpose to use all his powers for the good of the world was never changed. Nature was to him

lavish of her gifts. She endowed him with a commanding intellect, an inflexible will, and the frame of a giant. Fame, honor, fortune, were within his grasp. Our manufacturing interests were established and developed, and made remarkably successful, by his strong faith and rare business ability. He was a great man. He could hardly help achieving success. He amassed a large fortune. What did he do with it? Not a dollar was wasted in vain display, or in gratifying depraved appetite or base passion. First of all, he cared for his native town, doing all he could to make it attractive and prosperous. Hence he built fine churches, provided liberally for public worship, advocated and practised temperance, obeyed and enforced law. But he did not stop here. He had the whole world in his heart. He gave freely to home and foreign missions, and proved his interest in all benevolent enterprises by generous contributions. Yet he preferred to aid *permanent* institutions. His largest benefactions were to colleges and schools. It was his highest joy to be permitted to originate influences which would last through all time, developing man's noblest powers, and making each generation wiser and better than the one before it. In this spirit he founded Williston Seminary, and endowed it with a million of dollars. And it will live and keep the town alive, and go on blessing the world till time shall be no longer. Thus Mr. Williston is still a real, living, mighty power in the midst of us to-day. May it not be that he is now doing even more for our good and the good of the world, than in the prime of his manhood? The good he did lives after him, his works follow him, and every day the good seed which he scattered is bringing forth a more abundant harvest. A life devoted to the service of Him who was the light of the world,—how good in itself, and how glorious for what it achieves!

Edmund H. Sawyer, though cast in a very different mould, was animated by the same purpose. As a business man he had few equals. He looked through any proposition and saw all its details at a single glance. This led to great promptness in deciding, and a full assurance that his decision was correct. Confident that his plans were well chosen, he never feared the issue, and, amid all difficulties, pressed on with

unfaltering courage to achieve success. He was wonderfully prosperous. There were very few men in western Massachusetts whose yearly income was equal to his. But did he make his money by grinding the faces of the poor? His employees were his partners, the sharers of his prosperity. He was their best friend; they loved and trusted him; he cared for them, and gave and loaned them money as they needed. And whom did he not help? His large, warm heart responded to every appeal. It opened his purse to supply every want. The churches and schools were enlarged and strengthened by his zeal and liberality. For this town hall and the public library we are indebted to his love for Easthampton. He gave his time and strength and money gladly and without stint for everything that promised to be a blessing to the town. It was his aim to do all possible good to others, to bless everybody but himself. His very presence was a rebuke to meanness and selfishness, and an incitement to deeds of kindness. His great love shone in his face, and in the grasp of his hand you felt the throb of his warm heart. And his spirit lives in the midst of us to-day, moving us to imitate his example, and strive not to get, but to give.

Of what priceless worth to this community are the lives of these two men, — Samuel Williston and Edmund H. Sawyer. But who can estimate what it was worth to them to live as they did, — not to win fortune and fame for themselves, but to bless the world? Could they have made a wiser choice? Could any other purpose have so crowned them with honor? Did ambition ever win or riches ever purchase such glory as rewards their unselfish devotion? Is not an earnest, unselfish life the best life for every man to live? I do not mean best in its promises and hopes, best for the next world, but best now, every day, because of the satisfying joy which is every day poured into the soul. I have no faith in a religion that demands wretchedness and suffering here as the price of eternal happiness hereafter. The life that deserves eternal joy will have a blessed foretaste of it here. Our Lord declared that whoever gives up all earthly good shall receive manifold more, not in the far-off future, but in this present time. Good deeds pay down. Self-sacrifice is rewarded on

the instant. The great truth enforced by the example and the words of our Lord, that "it is more blessed to give than to receive," ought to be realized in every man's experience. It is worth while to be a good farmer, a good mechanic, a good merchant; but it is worth infinitely more to be a good man. We have seen what two such men have accomplished in a single town. No wonder that ten good men could have saved Sodom. Surely ten men of this class in every town in this Commonwealth would suffice to banish the great evil which our legislators have striven in vain to remove. How shall this number be made up? Let these sturdy, clear-headed, order-loving farmers answer the question. Will they not themselves at once come to the front, and make the number good? Will they not also swell the ranks by fitting their children to follow their example? Can there be any better training-school for such a purpose than the farmer's home? If only every farmer would live an earnest and unselfish life, the whole world would be saved.

The visible results attained by the skilled tiller of the soil deservedly awaken our high admiration. To convert the barren waste into a fruitful field, to make the desert blossom as the rose, is a noble work, worth all it costs. But let there be added to this, a saved world, no more wrecked lives, everywhere the glory of the redeemed!

ADDRESS BY THE CHAIRMAN.

DR. GEORGE B. LORING OF SALEM.

I have been requested, gentlemen, to preside over this day's proceedings, not because I have in recent years been connected with the Board, but, I suppose, because the antiquity of my connection had appealed to the secretary. In discharge of this duty, I desire to call the attention of the Board to the organization of these meetings, to the steps by which they were reached, and to the benefit which they have exerted upon the agriculture of the Commonwealth of Massachusetts; and I shall make my statement as brief as possible, with the hope that I may instruct and interest you in the work consigned to your care.

In 1861, on the 12th of December, at the meeting of the Board then sitting in Boston, I offered a resolution that it

would be of benefit to the Board and the agriculture of the State to have meetings held in other sections of the Commonwealth than in Boston, and at other seasons of the year than winter; and the resolution contained the idea that there should be three meetings during the season,—one at Worcester, one at Springfield, and one at Pittsfield,—it occurring to my mind that that was about the length of the Commonwealth itself.

The resolution was referred to a committee, from which, by some unaccountable oversight of the presiding officer of that day, my name was omitted, and which was organized in antagonism to the resolution. The report of the committee was, that the financial burden then resting upon the Commonwealth was so great that it was impracticable and hardly proper that the expenses of the State should be increased by the encouragement of the Board of Agriculture,—a board which we thought at that time, and think still, is entitled to as much consideration as any other board in the Commonwealth. That report was accepted in February of the year 1862. True to the perseverance and energy of every Massachusetts farmer, in December following, one year after my first resolution was proposed, I offered another resolution, having stated that, while we considered Massachusetts was burdened by the great obligations of the war, and that the necessities of the times did make economy imperatively necessary, still, we thought, in view of the fact that other States were engaged liberally and somewhat extensively in encouraging agriculture, Massachusetts, which we looked upon as a prosperous and powerful Commonwealth, ought to do her duty also in that direction. I suppose these remarks produced an influence favorable to the Board; and in December, 1862, I offered another resolution, stating that the business of the Board should be distributed among the farmers themselves; and that, whenever the usefulness of the Board should be perfected, it would be found that country meetings would be of the utmost service, and that the influence of those meetings on the agriculture of the State would be rapidly and largely felt. That resolution was referred to a committee; and, the courtesy of the presiding officer having placed me upon it as chairman, in January, 1863, I offered

another resolution providing for these very meetings, one of which you are now holding here to-day, and stated that the effect would be rapidly felt upon the farmers of the State. Mr. John Brooks of Princeton (many of you remember him), one of the most earnest and intelligent farmers in the Commonwealth of Massachusetts, and Colonel Wilder, whose memory is dear to all of you here and to all cultivators of the soil throughout the Union, and myself, were appointed a committee to organize these meetings. In that way this series of assemblies commenced.

The first meeting was held in December, 1863, just two years after my first resolution was proposed. It was held at Springfield, and there were gathered together a body of men who satisfied at once the officers of this Board, who were previously filled with doubts in regard to the success of the enterprise, that the farmers of the Commonwealth were an intelligent and thoughtful body, even in those original days; notwithstanding the fact that we had been told that the Board itself and the farmers of the Commonwealth were not sufficiently well trained to carry on such service as has been rendered from that day to this, that the debates could not be of value, and the meetings themselves would not be of any interest to the people of the State. Now, gentlemen, how has this turned out? Why, from 1863 to this hour the country meetings of the Board have constituted the great strength and power of the Board, as I think. We have had most excellent and able secretaries, who have done their duty well; but they will all tell you that the contents of the reports which have been of actual service and interest to the people of the State — to the farmers themselves, especially — have grown out of the lectures and debates at the country meetings of the Board. The effect of these meetings should never be forgotten.

The relation of the farmer to the cultivation of the public mind is a most interesting question. The farming instinct which carried this State on for two centuries and more in the great business of cultivating the somewhat sterile soil in an unpropitious climate succeeded largely, it is true; but the time had arrived when the application of the most carefully prepared and most scientific principles and practice

became imperatively necessary; and when the country meetings of this Board were established, the agricultural community was just stepping out of the bonds of mere traditional agriculture into the work of careful and scientific agriculture, — that which from that day to this has constituted the success of farming in this Commonwealth. In all those States where the population has largely increased, where the local markets have multiplied, and where the demand has been made for the most accurate and careful system of farming, it is the application of economical and scientific methods which enables a farmer to secure a competence for his family, and to keep himself in line with the progressive thought and work of the country.

Now, it is well for us to consider exactly what application we can make of all the scientific and careful investigations, all the nice and delicate inventions, to the occupation to which we are devoted. The time was when you could tickle the soil, and the harvest would rush into your arms; but that time is past. The selection of crops with great skill, the application of fertilizers to the land, the choice of crops that are appropriate to the local market, the management of all the machinery of the farm, have become as much a matter of care and attention as the management of cotton and woollen mills and all their machinery, which have made the Commonwealth what it is. The time has come, when, by college and by board, by association of every description, and by personal influence, the theory and practice of farming should be advanced; when farming should be no longer a tradition or a theory, but a careful and accurate system of business, like all the rest of the business in this State in which all are interested either as consumers or producers.

The influence of these meetings upon the agricultural mind of the Commonwealth, as I judge, has been to prepare that mind for the reception of that systematic education to which I have referred. The meetings themselves have been highly creditable to the practical men who have attended. The useful essays that have been delivered; the careful discussions and well-drawn laws, drawn from experience; the application of all those rules by which farmers have succeeded, have been laid before the community through these

country meetings in a way which has enabled those engaged in the practical work of farming to understand exactly what their position is, and how they can best conduct the business which has fallen into their hands.

I have great faith, and always have had, in the influence of agricultural colleges; but my faith in them has been confirmed more by the stimulating and rousing and cultivating effect they have had upon the general agricultural mind, than by any actual rules of agriculture, which, so far as I am informed, have been presented or laid down. The introduction into our community of a body of young men who, for agricultural purposes, have cultivated their minds, has been a vast thing for the agriculture of the State. Everybody can feel that; and it has made the farmer himself, as he has been engaged in toil on his land, feel that his occupation was ranged alongside of those great professions which previously had assumed to themselves all the thought and all the culture and all the intellect of the community in which we live; so that now we have by the side of the great classical schools here a rising agricultural college, to lift the agricultural thought of the community on to that plane which will give it a companionship and connection with all the most intellectual and thoughtful professions in the State.

We have technology for our mills, we have practical schools for all our occupations; and, while they do not give us all skilful mechanics and skilful machinists and artisans, they do give us a body of men, who, for the practical service of life, have their faculties so cultivated that out of the great crop will rise leaders that will teach the State and world what are the possibilities of the business in which they are engaged. All clergymen that graduate from theological schools are not great preachers; all lawyers that graduate from law schools are not great lawyers; all graduates of our colleges are not great students. But they belong to a cultivated community; and, because that community is cultivated, the leaders in these professions to which I have alluded naturally spring up as the best plants grow out of the best cultivated field. The crop is not all uniform. But, as there are superior plants in every man's crop, so in

a cultivated community there are superior minds growing up out of the influence of the abstract cultivation itself. Now, the college has done that for this community, and may do more; and I trust we shall all see the time when a professor analagous to a professor of the theory and practice of medicine will be considered as the corner-stone of the agricultural college of this Commonwealth. I have no doubt young men come out of the school better prepared for agricultural service than they were when they went in there; but when they come out so imbued with the theory of agriculture and so taught in regard to its practice that they will enable you to conduct your farming operations here under their guidance with economy, accuracy and skill, then the purpose of that college, as those of us anticipated who were active in its foundation, will be thoroughly fulfilled. Now, while the college is engaged in this work, the Board in these meetings is engaged in other work by bringing practical farmers together, so that they themselves may accept the doctrines laid down at the college, and be better enabled to carry home to the communities from which they come the results of those teachings, not only in the facts or rules of agriculture, but in the general business of stimulating the agricultural mind of the Commonwealth. I therefore congratulate the Board upon the result of these meetings, for the foundation of which I labored so diligently and with so much entire confidence in the success of the enterprise.

I have not been enabled to do a great many useful things in my agricultural life. I have endeavored to improve the breeds of cattle and horses of the Commonwealth by the introduction of well-approved blood into our herds and studs, not always with the success I had hoped for. I have endeavored to persuade the farmers that corn-fodder was not quite what it ought to be, unless grown to some maturity, and have advanced various views, some sound and some unsound, I suppose; but there is one good thing I have done, I am confident, and I propose to impress it upon your mind, — and that is, the foundation of these country meetings that bring the farmers themselves together, and place them alongside of the intellectual activities of the colleges themselves. I think the Board, the country meetings, and the college,

with their stimulating agricultural teaching, have already had a vast influence upon the agriculture of the Commonwealth. And when you remember, gentlemen, who have gathered around these meetings, you will then see why it is they have had so much interest attached to them, and why it is they have really been of such practical benefit to the farmers of the Commonwealth. I have heard discussions upon the theory and upon the practice of the breeding of animals, at these meetings, between the practical farmers themselves and the great teacher Agassiz, that were worthy of being introduced into any scientific report on earth; and I am sure the members of the Board and the audience present who went out of those meetings, after having listened to debates by men of that description, — the great theorists on one side, and the men of practice on the other, — must have realized that the farmer and scientist had a close association, which might be of benefit to both. While you might not have realized quite the vast value of the statements made by Professor Agassiz, I can say that he had entire confidence in the statements made to him, and that from them he drew some of the finest of his scientific conclusions. I congratulate you, therefore, on the work performed by the Board; and that the results of teachings here have been recorded for now twenty-five years, — one quarter of a century; and that there is for you, and for those who come after you, this record of practical agriculture, which will always be esteemed of high value by the agricultural students of this Commonwealth and of the country.

I desire, in conclusion, to express my thanks to Dr. Seelye, who has kindly opened your discussion here by the presentation of the power of diligence and skill and high moral tone and great religious purpose, when devoted to the duties of life, in this and in every other community. His statement has been an enjoyment. The great walks of life to which he referred are not open to us all. While the cultivation of the soil may not lead to such high avenues of power and such great distinction, it does constitute the community out from which these great qualities spring, and to which they may be effectually applied; and the farmers themselves make up that sturdy and substantial and constant

and reliable body of citizens, who can understand thoroughly well, and appreciate the example and accept the rules and moral force of those great lives to which he has alluded. I congratulate you that we have been able to meet in a town where such examples can be presented to us; and I am sure that the Board itself must be grateful to him for the picture that he has drawn of New England life, and for the opportunity that New England life itself affords for such human plants to grow up, the pride and glory of the Commonwealth in which we live.

The first lecture of the session will be of the description which I have given you; that is, the teachings of a practical farmer with regard to one of the most delicate and difficult questions known to agriculture, — the application of commercial fertilizers, prepared by science itself, to the cultivation of the soil. I have the pleasure of introducing to you Mr. Silas G. Hubbard of Hatfield, who will speak of his experience with commercial fertilizers.

EXPERIENCE WITH COMMERCIAL FERTILIZERS.

BY S. G. HUBBARD OF HATFIELD.

In the year 1845 I was a student in this goodly town of Easthampton. About that time, if I am not mistaken, Dr. Gray issued the first American book upon the subject of agricultural chemistry, and it was adopted as a text book in Williston Seminary. A farmer's boy, I was attracted by the title of the book, and took it up in my course of study. It furnished some of the facts, as I remember, about the formation of soils, germination of seeds, growth of plants, and generalized about the new idea that chemical science could be made useful to agriculture.

Although far behind the advanced thought and experience of the present day, it secured a good purpose as a first step in the right direction; it stimulated thought, produced a condition of mind to welcome the advent of more advanced ideas, and cultivated a spirit of eagerness to try new systems of agricultural improvement.

Some of you may remember how, at that time, and even later, "book farming" was scoffed at and ridiculed by prominent farmers of that day, and how some of them lived

long enough to admit the benefit science has since conferred upon agriculture.

In the use of fertilizing materials, the farmers of that period were limited to the use of animal manure, wood ashes, plaster and lime; and the most of them used manure alone to stimulate the growth of such crops as they produced for home consumption and the distant markets. Their surplus products of hay and grain were fed to stock, and converted into beef, pork, and mutton products for the New York and Boston markets.

For a period of thirty years, broom corn was the most profitable crop produced in some of the Connecticut River towns; but the rapid development of the rich virgin soils of the great West transferred its culture to New York State, Ohio, and Illinois, and now it is most largely produced far west of the Mississippi, on the fertile plains of Kansas and Nebraska. This competition has fairly driven Eastern farmers out of the business, to such an extent that one but rarely sees a field of broom corn east of the Mohawk valley. This competition has been going on, and is being constantly increased in the whole list of agricultural products. It was greatly stimulated by the building of new railroads, which are constantly being added to that vast system of Western roads, until now almost every county of the new States and territories have been reached, and their products brought to Eastern markets to supply the increasing demands for grain, flour, fruits and vegetables, as well as beef, mutton and pork products. It has become a serious problem to New England farmers how to meet this competition.

As bearing on the final solution of this problem, facts are constantly accumulating to prove that the Western farmers, with their improved labor-saving machinery, but otherwise primitive methods of farming, are annually robbing their virgin soils by making large drafts upon the limited amount of plant food they contain. Eventually, these lost elements of fertility will have to be restored by the application of commercial fertilizers. Bearing on this point, we find that during the past ten years manufacturers of fertilizers have found a growing demand for their goods in all the Western States east of the Mississippi River.

Eastern farmers should feel encouraged at the prospect of competing with their Western friends on more even terms in the near future.

The introduction of commercial fertilizers dates from the first importation of Peruvian guano into this country. This article was in convenient form to handle, ready for immediate application, and, when properly applied, was wonderfully effective in its action. It was at first experimented with in a small way, but not used very largely until about thirty-two years ago. In the years 1857 and 1858 I used it on a tobacco field of five acres, which had been highly manured in previous years, and found it produced astonishing results; and particularly in 1858, it produced the greatest growth of tobacco I have ever seen. This was the common experience of farmers who used it at that time.

A few years later, the supply of Chincha Island guano was exhausted; and, owing to the inferior quality of other guanos afterwards introduced, guano lost its place in public favor, and fell into gradual disuse.

About twenty-five years ago, Mr. Lyman Klapp, agent of the Union Oil Company of Providence, R.I., bought a twenty-four-acre tract of plain land in Hatfield. He employed a superintendent to till this land, and sent up the waste products of his mill as a fertilizer. This waste consisted of slightly damaged cotton-seed meal, cotton-seed hulls, and cotton-hull ashes, and these were the only fertilizers used.

One person at least carefully watched this new departure, and noted the crops that were grown. These crops, consisting of corn, rye, grass, onions and tobacco, were all excellent; and the quality, particularly of the tobacco grown in 1867 and 1868, was equal to the best I saw grown in those years.

In the year following, this land came into my possession, and experiments with fertilizers have been continued down to the present time. In the year 1873 I applied a good coating of green manure to four acres of the lightest part of this land, that had been run for several years without manures or fertilizers. I also applied two tons per acre of damaged cotton-seed meal, which cost thirteen dollars per ton, de-

livered. This tobacco crop, when packed, yielded over twenty-five hundred pounds of fine tobacco per acre, and the quality was such that it brought the highest price in the market.

This remarkable crop attracted considerable attention at the time; but most farmers gave the credit of growth to the manure, with but little to the cotton-seed meal. But few saw the great value of the meal as a fertilizer. It did not, however, come into general use as a fertilizer, even in Hatfield, until several years later.

The value of cotton-seed meal as a fertilizer is now generally admitted by farmers, and its use is being more largely increased from year to year, because it is found that the plant food it contains costs less than in most other commercial fertilizers on the market. Its most valuable constituents are nitrogen, phosphoric acid and potash. According to reliable analyses, a ton of cotton-seed meal contains about one hundred and forty pounds of nitrogen, which forms the basis to estimate its value. If nitrogen is worth seventeen cents per pound, the ton is worth twenty-four dollars for its nitrogen. It contains also about thirty pounds of potash and thirty pounds of phosphoric acid, valuable elements of plant food, which, together, are worth four dollars more, making the total value about twenty-eight dollars per ton.

Pure cotton-hull ashes are a valuable fertilizer, containing in their composition large percentages of potash and phosphoric acid. Their great value as a fertilizer has been known but a short time to the generality of farmers. Even now farmers have begun to lose confidence in them, because they so often contain much worthless foreign matter in their composition. They contain from twelve to thirty-two per cent of potash, according to the condition in which the material appears as an article in the fertilizer trade. They also contain a large percentage of phosphoric acid. They have proved to be a valuable fertilizer for grass, grain, and all kinds of cultivated crops and fruits.

Pure sulphate of potash contains fifty-four parts of potash and forty-six parts of sulphuric acid. High-grade sulphate of potash is gaining in popular favor among tobacco growers,

because the percentage of potash it contains can be depended upon, and the amount to be applied can be determined according to the requirements of soil and crop. It is convenient in form for use wherever potash is used for all kinds of crops.

Nitrogenous manures are chiefly of animal origin. One of the most important to the farmer is fine-ground sun-dried fish. It contains about eight per cent of high-grade nitrogen, and six per cent of phosphoric acid. Convenient in form for use, it is a valuable fertilizer.

Lime is the leading element in the composition of the leaves, fiber and wood of a large number of varieties of trees and plants in cultivation, as appears in their analysis. A good supply of lime in the soil promotes a healthful growth of foliage, and contributes to the pleasing, glossy appearance of the leaves of many trees and plants in cultivation. The ashes of most kinds of wood contain thirty-seven to seventy-three per cent of lime. All textile plants, turnips and some other vegetables, and all varieties of clover, contain a large percentage of lime. The experience and observation of twenty years has taught me that lime is a leading element of plant food, and is essential to the healthful growth of several important cultivated crops. Without health, man, plants or animals cannot reasonably be expected to contribute their best in the sharp competition that characterizes this age of progress.

In support of my statement as to the importance of lime, the following facts are given. The average of eight analyses of leaf tobacco, furnished by Professor Johnson of Connecticut, is of interest to tobacco growers. The dry leaf when burned produced twenty-five per cent of ash, which would make five hundred pounds of ash from two thousand pounds of leaf.

	Per cent.	Pounds.
Potash, ...	23.90	119.5
Carbonic acid, ...	20.27	102.85
Phosphoric acid, ...	2.64	13.
Lime, ...	22.50	112.5

Three elements, potash, lime and carbonic acid, compose sixty-eight per cent of the ash elements. The remaining

thirty-two per cent is made up largely of sand, soil, alumina, magnesia, sulphuric acid, phosphoric acid and chlorine.

In his thirteenth annual report, 1885, page 364, Professor Goessmann says carbonate of lime contains fifty-six parts of calcium oxide (lime) and forty-four parts of carbonic acid. Therefore, we find that lime contains two of the leading constituents of leaf tobacco; namely, lime and carbonic acid, which Professor Johnson found in larger relative proportions than any other single element excepting potash.

Considering the limits of the time assigned me, I have confined my attention to only a few of the fertilizer materials which I think from my experience are of greatest usefulness and profit in the production of special farm crops. Time will not permit me to speak of the many excellent fertilizer compounds manufactured in this country, presuming also that you are familiar with their history and usefulness. Neither is it necessary to take up your valuable time in the consideration of the other fertilizer material not mentioned, with which we have been practically familiar in times past. Perhaps it is not necessary for me to say that I can give you but a bare outline of my experience with fertilizers in the limits of this paper. The conditions of success in farming, at the present time, largely depend upon the careful saving of animal manures and liberal use of commercial fertilizers.

Commercial fertilizers are constantly growing in favor with all successful farmers of my acquaintance. To grow crops successfully for the early markets, they are highly valued; and their use is considered absolutely essential in open cultivation, to stimulate the rapid growth of special crops. The condition of early maturity of crops which the judicious use of fertilizers will enable the farmer to realize, serves also to insure him against the risk of frost, so often in this latitude destructive to crops of backward growth. This fact has been obvious to our farmers the present year. In my native town we have harvested one of the largest and soundest crops of corn known for several years, while in some sections of the State there is general complaint of much unsound corn, owing to the cool summer and the early frost.

The experience of the year has clearly demonstrated the usefulness of commercial fertilizers in forcing the early maturity of corn and other cultivated crops, which have brought higher prices in the markets and the early conversion of crop products into cash.

It is the intelligent, wide-awake farmer, who observes these conditions of success and takes advantage of them that can show the most satisfactory balance sheet at the end of the year.

The investigations carried on at the experiment station in Amherst are invaluable to practical farmers of Massachusetts. The analyses of fertilizer materials and fertilizer compounds, continually going on, furnish to our farmers reliable information as to their composition of plant food and comparative value. We have also at hand the investigations of eminent scientists of the old world, who were earlier in the field (giving the ash composition of meadow hay and grasses, clover and fodder plants, root crops, their leaves and stems, refuse and manufactured products, straw, chaff, textile plants, litter, grains and seeds of agricultural plants, fruits and seeds of trees, leaves, wood and bark).

This important work has revealed some of the hidden secrets of nature, creating a new departure, by pointing out the way to a more economical production of farm crops. These important analyses have formed a basis of positive knowledge in this country since the year 1868, and have stimulated subsequent experiments in the formation of fertilizer compounds for special crops, suggesting the idea of supplying to the soil the elements of plant food corresponding in quantity and kind to the constituents found in the plant.

This principle has been applied by farmers in Massachusetts and Connecticut, for a period of about ten years, in the production of tobacco. The results have been very satisfactory, not only in the growth of fine crops which have brought the highest prices in market, but in reducing the cost of production to a paying basis, making a large saving over the old way of hauling large quantities of expensive animal manures from the railroad station to the tobacco field. Many farmers in Hatfield have been successful in the production of excellent crops of corn, potatoes, hay and grain

for a succession of years, following a system of crop rotation without animal manure, using commercial fertilizers alone.

Besides the lot before referred to in this paper, I have a large acreage of plain land that came into my possession fifteen years ago, which has been treated wholly with commercial fertilizers. This land has produced paying crops of grass, corn, potatoes, rye, oats and tobacco, and the fertility of the soil has been fully maintained.

I have found by experimental tests that all of my cultivated lands were naturally deficient in potash and lime; and I have taken this condition of the soil into account in my application of fertilizers.

I am satisfied that no single formula, with certain fixed percentages of nitrogen, potash and phosphoric acid, can reasonably be expected to apply equally well on all soils for the same crop; therefore, in practice, I have varied the percentages according to my best knowledge of the condition of the soil, and requirements of plant food of crop cultivated. I have found unleached ashes an excellent fertilizer to bring in a good catch of clover. Clover itself often performs the office of a fertilizer by pushing its long tap root into the lower subsoil strata, and pumping up the nitrates and other stores of plant food to the surface soil, which brings it within the reach of other special crops that follow.

Sandy soils, when not properly treated, are often found deficient in vegetable matter or humus. This deficiency can be supplied in a variety of ways, according to circumstances, either by ploughing in coarse barnyard manure, clover sod, stubble, cornstalks, tobacco stems, or some other cheap vegetable material. This I should call preliminary work; afterwards I would apply the plant food according to the requirements of the crop.

I wish to say, in conclusion, that there are certain important conditions which must be observed, if we expect to secure the highest possible returns for our outlay of capital invested in fertilizers.

1. Unless the natural drainage is perfect, provision should be made to carry off all surplus water from the land. This can be done in most cases at small expense by underdrainage.

2. Good ploughing at the proper time and thorough pulverization of the soil, followed by careful culture of the crop and careful handling of the product.

3. The fertilizers should be selected from high-grade material, and free from all deleterious compounds, in fine condition, and applied broadcast to the soil. The use of a good fertilizer drill makes a large saving in the work, and secures a more perfect distribution of fertilizers.

The CHAIRMAN. The remaining lecture of the forenoon will now be given by Prof. G. H. Whitcher, director of the New Hampshire Experiment Station, upon the subject of "Chemical Fertilizers." I have the pleasure of introducing Professor Whitcher.

CHEMICAL FERTILIZERS.

BY PROF. G. H. WHITCHER OF HANOVER, N. H.

The subject which I shall discuss to-day is so much like the one already presented, that I will not attempt to follow any definite line, but will simply give you a talk, and as far as possible will make my remarks cover different ground than that so well gone over by the speaker who has preceded me. If, in the attempt on my part, my remarks should be a little rambling, I hope you will pardon the lack of definiteness. I also want to say to you that I shall be very glad to have any one break in with questions at any point. You can easily ask questions that I cannot answer; but I will frankly say that I don't know, when such is the case.

I shall endeavor to suggest answers, or partial answers, to three questions: —

1. WHAT DO PLANTS REQUIRE?
2. WHERE SHALL WE GET THE MATERIALS THEY NEED?
3. HOW SHALL WE APPLY THE SAME?

If I could fully answer these three questions, I should know more about fertilizers than any other living man; but I want to say that such is not the case, and I can only give you a few ideas on each.

What do Plants require?

That is the question I asked myself when I commenced the study of this problem. To know what a plant requires,

I wanted to know what it is composed of; accordingly I selected a stalk of ensilage corn, which, when cut, weighed exactly five pounds. What was this stalk made up of? This question was answered by chemical analysis, in the laboratory. It was found that eighty-two per cent of the stalk was water; the starch, sugar, oil, etc., were also determined, and as a result the following table was prepared, showing just what amount of each constituent was contained in this one stalk: —

A stalk of corn weighing five pounds: analysis.

Water,	65.60 oz.
Albuminoids,	.88 oz.
Sugar,	3.04 oz.
Starch,	5.60 oz.
Fiber,	3.60 oz.
Fat,	.40 oz.
Ash,	.88 oz.
	80.00 oz.

But figures are hard to remember, and I have in these bottles the exact amount of each constituent, except the water. If I had here a two-quart fruit jar full of water, it would represent the exact quantity that was found; so, if you will imagine such a jar, containing two quarts of water, you will have a representation of the entire stalk. This bottle contains the exact quantity of starch that the above-mentioned stalk contained; in this bottle we have the sugar; in this, the oil; and in this, the albuminoids, or the portion that goes to make muscle, and the caseine or curd of milk when the corn is fed to cows. This last is the most valuable constituent of the food. In this bottle I have the amount of ash.

QUESTION. What was the condition of this corn; was it mature or immature?

ANSWER. The stalk was the "Burrill & Whitman" corn, and had one ear, the kernels of which were "blistered." Remember that these bottles show us what the stalk was made up of, and the exact amount, so that you have before you here a stalk of corn taken apart, so to speak; the various parts put in separate packages, just as we might take a mowing-machine apart, putting the cast-iron in one place, the steel in another, the bolts, nuts, screws, etc., each in a box by itself.

Now, how did each of these several constituents affect the soil from which the stalk was nourished? The starch, sugar, oil and fiber came from the air and water; that is, they are made up of three elements, — carbon, hydrogen and oxygen, — and these are taken, the first from carbonic acid, which is present in the air, and from water, which may come from the air or soil. Thus it is evident that neither the pocket-book of the farmer nor his soil is the poorer on account of the starch, sugar, oil or fiber produced; the elements from which they are made come to us free in the winds that blow and in the rain and snow. It is also true that eighty-five per cent of the albuminoids are made up of the same elements; the remaining fifteen per cent is nitrogen, and for this we pay fifteen cents per pound when we buy fertilizers. There has always been a great deal of discussion about the supply of nitrogen for plants. Great men have claimed that plants take nitrogen from the air, and great men have claimed that plants cannot take nitrogen from the air; and between the two opinions I am free to say that I do not know whether plants take up nitrogen from the air or not, and I doubt very much if any man does know.

There is a part of the plant, however, that does not come to us free; it is the ash. The ash of plants is not contained in the air, and must come from the soil. In this bottle you see the amount of ash that the roots of that single stalk of corn took up, and you may be sure that it came from the soil in which it grew.

Question. What amount of these various constituents were there?

Answer. I will give you the amount per acre; for we found the yield to be twenty tons per acre when cut. It is as follows:—

	Pounds per acre.
Water,	32,800
Albuminoids,	440
Fiber,	1,800
Sugar,	1,520
Fat,	200
Starch,	2,800
Ash,	440
	40,000

The ash is the part that interests the farmer, because it contains the substances which we are obliged to furnish in fertilizers. But the question at once comes up, do we need to furnish the whole of the 440 pounds? It has been found that we do not need to do this; and, that we may know what is needed and what is not, I have separated the ash in this small bottle into the various substances contained in these vials. I will give the substances and the amount per acre:

Phosphoric acid,	47 lbs.
Potash,	130 lbs.
Soda,	18 lbs.
Lime,	65 lbs.
Silica,	162 lbs.
Magnesium,	18 lbs.
	440 lbs.

There was also seventy pounds of nitrogen contained in the albuminoids.

In the table we see that this crop removed from the soil forty-seven pounds of phosphoric acid; and, as will be shown later, this substance is one that is usually deficient in worn-out soils. Potash is another element that more frequently fails than any other. Our crop removed 130 pounds of this.

Soda has been shown to be less essential than almost any other substance in the ash; plants can and have been grown in the absence of this. Lime is essential to the growth of plants, but it is not often deficient in New England soils. The speaker who preceded me has shown you that for tobacco it is necessary to apply lime, but for most crops on most soils it is not necessary to make any additions to the lime already present; thus, our sixty-five pounds of lime may be disregarded. All of you have noticed the hard glazing or coating on the outside of corn stalks, and on straw, etc.; this is silica. It is never applied as a fertilizer, for the soil yields enough in most cases; consequently, this 162 pounds may be left out of the account in fertilizing for our farm crops.

The eighteen pounds of magnesia also can be set aside in nearly all cases, though there are soils where it seems bene-

ficial; but the cases are rare. These little bottles that I have here show you the exact amount of each of these constituents that was in the single stalk of corn, and of the six, four may, in most cases, be disregarded; the other two, namely, phosphoric acid and potash, are needed and must be provided for in old soils.

The phosphoric acid, that is always spoken of in fertilizer analyses, is this white powder which I have in this bottle; so that an analysis showing twelve per cent of phosphoric acid, means that in one hundred pounds of the fertilizer there are twelve pounds of this white substance.

Now, what have we shown thus far?

1. That a crop of twenty tons of ensilage corn is made up of various substances, some of which come from the soil, others from the air. We have seen that 39,490 pounds out of the total forty thousand comes from the air, either as water or carbonic acid. Also, that 263 pounds of the ash is nearly always over-abundant in the soil; leaving 177 pounds of ash to be provided, either wholly or in part, and seventy pounds of nitrogen, a part of which, at least, must be supplied.

Potash is very essential, for not a grain of starch can be formed in its absence; and as starch or some similar substance is the foundation of all the other parts of a plant, it follows that a plant cannot grow without potash. Phosphoric acid has some direct influence in the production or transfer of the albuminoids, and is especially valuable in those crops that contain a large amount of the latter.

How has it been shown that Nitrogen, Phosphoric Acid and Potash are needed by Crops?

The whole science of fertilizers dates back to the accidental discovery that bone produced favorable results when used in place of animal manures. This discovery was made by a farmer in England, as long ago as 1750. It is true that lime, plaster and nitrate of soda were used previous to this, but no attempt was made to ask why they gave increased yields.

In 1750, or about that time, an English farmer made use of the waste bone and burnt chips and shavings which the

proprietor of a comb and button factory had caused to be dumped in a swamp as rubbish; the effect was very gratifying, and from that time the use of bone dates.

It soon became known that crushed bones were superior to whole ones, and in 1814 a bone mill was constructed to crush and prepare this new manure. The novelty of the use of bone manure is mentioned in the writings of Arthur Young, who, on returning from a tour of Northern England and Scotland in 1770, said: "Bones are a very odd manure, but they find them of great benefit to their clay lands and they will last twenty years good." It was asked, after a time,

WHY DO BONES ACT AS A FERTILIZER?

First Theory. — Bones were known to be made up of two parts: one that would burn, called the "animal matter;" the other, incombustible, called "mineral matter." It was known that animal manures from farm-yards caused crops to yield well, and so it was natural to attribute the beneficent action of bones to the animal matter they contained. One hundred pounds of bone will contain not far from thirty pounds of "animal matter" and seventy of "mineral matter" or ash. The thirty pounds received the credit for the effects that were so clearly due to the application of bone. This theory was all right until it was proven to be wrong. Some Englishman, with true Yankee inquisitiveness, burned the animal matter out of a lot of bones, and used the ash; the result was even more satisfactory than with the whole bone. A new explanation was not only in order, but necessary.

The following represents an analysis of bone: —

100 lbs. raw bone,	Animal matter, 30 lbs., containing, —		Nitrogen, 2.5 lbs.
	Mineral (ash), 70 lbs.,	58 lbs. phosphate of lime.	Phosphoric acid, 24 lbs. Lime, 34 lbs.
		12 lbs. other substances.	
Total plant food, ...			26.5 lbs.

Now, if we remove the thirty pounds of animal matter, the ash must cause the effect that is known to be produced; the lime, in the amount commonly used per acre, could not ac-

count for the results, and hence the phosphoric acid must be regarded as the valuable constituent of bones. This was the reasoning which led to the true theory of the action of bone; the date of this conclusion is from 1830 to 1835.

We find mention of the use of "saltpeter," or nitrate of potash, in 1625, but there are no definite records until 1825 to 1829.

In 1836, an effort was made by an English farmer to determine the true cause of the wonderful effects of "saltpeter." He knew that this manure contained nitric acid, combined with potash, and he planned an experiment on grass. Three equal areas were measured off and were treated as follows: No. 1, watered daily with pure water; No. 2, watered daily with water in which potash was dissolved; No. 3, watered daily with water with which a little nitric acid was mixed. The result was that No. 1 gave the least yield, No. 3 was increased considerably, and No. 2 still more. This experiment showed that the nitrogen of the nitric acid and the potash were each useful to the growing grass. Thus it was established, by practical farmers, that nitrogen, phosphoric acid and potash are forms of plant food that exhausted soils need.

The second question mentioned at the commencement of this talk concerning the services of plant food, was this: "WHERE SHALL WE GET THE MATERIALS THEY [PLANTS] NEED?"

Phosphoric Acid.

Bone, as already stated, was the first source of this variety of plant food. The following tabulated statement shows the probable date of use and discovery of materials containing phosphoric acid: —

1750. Bones first used in England.
1814 First bone mill used in England.
1780. Bones first used in United States.
1820. First bone mill used in United States.
1837. South Carolina rock first mentioned.
1839. Liebig suggested the use of sulphuric acid to dissolve bone.
1840. *Dissolved* bone first used.
1843. Spanish phosphate rock first mentioned.
1845. Spanish phosphate rock first used in England.
1851. *Dissolved* bone first used in United States.

1868.	South Carolina rock first mined, in all 6 tons.						
1878.	"	"	"	amount mined, 58,760 tons.			
1880.	"	"	"	"	"	163,000	"
1883.	"	"	"	"	"	332,077	"
1885.	"	"	"	"	"	437,856	"
1886.	(?) Thomas-Gilchrist slag first used.						

To-day it is said that two-thirds of all the phosphoric acid used in commercial fertilizers comes from South Carolina rock. This rock is found about Charleston, S.C., although it is not confined to one locality, but occurs in both Carolinas and in Florida.

Bone-black is a common and very desirable form of bone which yields about thirty-four per cent of phosphoric acid. It is simply bone charcoal. It is used by the sugar refiners for removing color and impurities from crude sugars; in time, however, this charcoal loses the power of purifying, and is then sold to fertilizer manufacturers. Phosphoric acid is present in fertilizers in three forms: one soluble in water; one insoluble in water, but soluble in vegetable acids, and the third insoluble, except in strong acids. The phosphoric acid in bone, bone-black, South Carolina rock and Spanish rock is insoluble, belonging to the third form; that in the Thomas-Gilchrist slag is soluble in citric acid. The basis of Liebig's suggestion was the fact that bone, if treated or "cut" with sulphuric acid, has its phosphate of lime changed from the insoluble to the soluble form; and his reasoning was that a comparatively small amount of bone, if rendered soluble, would supply as much *available* plant food as a much larger quantity of raw bone. This was, in practice, found to be true; six or eight bushels of bone dissolved with sulphuric acid would yield as large crops for the first year as would fifty bushels of crushed bone untreated. It is now the general practice of all fertilizer manufacturers to treat all phosphatic material with acid; so that we have dissolved South Carolina rock, dissolved bone-black, dissolved bone, each of which furnishes a good per cent of soluble phosphoric acid.

It is claimed, however, that the "slag phosphate," though insoluble in water, is nevertheless available to plants. The truth of this needs more demonstration than has yet been given.

Potash.

Nitrate of potash, as has been intimated, was formerly used on wheat in England; but the use of this material in the manufacture of gunpowder has so far increased the price, that it is out of the reach of the farmer.

Wood ashes constituted the chief source of potash until 1868. As early as 1852, a salt mine was opened in Stassfurt, Saxony. Salt was not reached until a depth of eleven hundred feet was reached; this did not occur until 1857. In digging this shaft, a bed of "potash salts" was passed through. For a time these were regarded as not only worthless, but a hindrance to the salt mining. In 1861 a company was formed to work up these salts, and a factory was built. In 1883, thirty-four factories were engaged in purifying these potash deposits. Only a small part of their out-put (fifteen per cent) is used in fertilizers.

The first potash landed in this country from the German mines, was consigned to Dr. Gould of Cambridge, Mass., in 1868.

On the market to-day we find: —

Muriate of potash, containing . . .	50 per cent of actual potash.
Sulphate of potash, containing . . .	27 " " " " "
Sulphate of potash (high grade), containing	51 " " " " "
Kainit, containing	12 " " " " "
Krugit, containing	8 " " " " "
Ashes, containing	6–9 " " " " "

Nitrogen.

Bones contain two and one-half per cent of nitrogen; nitrate of potash contains thirteen per cent of nitrogen. The next nitrogenous fertilizer was the "Chili saltpeter," a substance mined in South America; it contains fifteen per cent of nitrogen. The first ship-load of this that reached England found no market. It was then sent to America.

In 1836 a new material was used in England, the so-called "gas liquor." This is the water through which illuminating gas is washed. This water absorbs the ammonia which comes from the combustion of the coal; and as ammonia contains nitrogen, it is a nitrogenous fertilizer.

Later, the same liquor was prepared with sulphuric acid, giving sulphate of ammonia, which, to-day, is one of the sources of nitrogen used in good fertilizers. The best quality of this salt contains twenty per cent of nitrogen; dried blood contains fifteen per cent; fish scraps, seven and one-half per cent; guano, fifteen per cent.

How shall we use these Materials?

The most natural answer is: Buy some one of the multitude of prepared fertilizers (*commercial fertilizers*). I do not advocate this, however, for several reasons.

1. The fertilizers found on our market are constructed upon a wrong foundation, and are consequently, in my opinion, poorly adapted to the wants of our crops. Let me make this point clear. Take any ten fertilizers found on our market and average their percentage of plant food, and you will find about the following: —

Phosphoric acid (total), ...	12 per cent.
Potash, ...	3 per cent.
Nitrogen, ...	2 per cent.

This is approximately the average composition. Now the practical question is this: Does this ratio, or this combination, meet the requirements of our crops? I answer, No! I have here a chart which shows you the nitrogen, phosphoric acid and potash taken from the soil by the following crops, per acre: —

	Herds-grass.	Red Top.	Alsike Clover.	Ensilage.	Corn Meal.	Corn Stover.	Total Corn.
Phosphoric acid, .	18.40	15.60	40.40	52 00	28.80	19.00	47.80
Potash, . . .	61.20	42.00	109.60	144.00	17.60	83.00	100.60
Nitrogen, . .	50.40	49.60	87.60	164.00	82.40	43.00	125.40

Now, you will see that these five crops took from the soil 173.4 pounds of phosphoric acid and 457.4 pounds of potash;

that is, nearly three times as much potash as phosphoric acid. But the fertilizer manufacturers tell us that plants want three or four times as much phosphoric acid as potash. Now, who is right? Do the plants themselves know what they want? Do they take what they want and in the proportion they want it, or are the plants mistaken and the fertilizer manufacturers right? I prefer to believe that the roots of a plant are tolerable judges of what the plant requires for its best development. Plants want potash and phosphoric acid in the ratio of three to one; they get these materials in *prepared fertilizers* in just the reverse ratio.

This, you will say, is all theory. Well, yes. It was *theory* that caused Liebig to give us the greatest of all blessings in agriculture; namely, soluble phosphoric acid as plant food. It was theory that made possible the great Brooklyn bridge. But let us see if our theory is true when tested by the rules of practice. The following table shows the effect of fertilizers having varying percentages of potash; the first column shows the percentage of potash in the fertilizer used, and the second shows the value of the increase of crop due to one dollar's worth of fertilizer.

	Per cent of Potash.	Value of Increased Crop, etc.
	0	$0.06
Prepared fertilizers, . .	2	1.55
Chemicals,*	8	2.45
"	10	2.89
"	11¼	2.64
"	20½	2.91
"	25	3.83
"	32	3.32
"	50	0.42

The figures in the last column represent the whole value of increased crop, and, of course, the value of the fertilizer. In all cases one dollar has to be taken from the figures to show the true profit or loss.

Now you can see that increasing the potash increased the value of the fertilizer, and I am of the opinion that our

* By chemicals I mean dissolved bone-black, muriate of potash, sulphate of ammonia, krugit, nitrate of soda, etc.

fertilizers should contain at least ten per cent of potash, and I do not care to have more than ten per cent of phosphoric acid.

QUESTION. What was the crop?

Professor WHITCHER. Corn, in the cases I have just given. I find the same thing true of grass: more potash, more grass!

QUESTION. Will you please explain the difference between muriate and sulphate of potash?

Professor WHITCHER. One is potash combined with hydrochloric acid; the other, with sulphuric. This is the chemical difference. So far as their use is concerned I do not know that I can tell you the difference. I should generally use muriate; but I believe it is contended that the quality of potatoes is affected by one more than the other. I am not certain which is said to give the best quality, but think it is the muriate. I have looked more to quantity than quality in the matter; perhaps too much so.

BENJ. P. WARE of Marblehead. I think there is one point that is not quite clear. You have shown that bone, dissolved by sulphuric acid, becomes soluble; that is, it contains plant food. Now, do I understand by that that ground bone contains no plant food? I would also like to ask whether there is any plant food available from South Carolina rock or iron slag without previous preparation?

Professor WHITCHER. I did not intend to give the impression that there was no plant food in bone. Phosphoric acid is plant food wherever it is. It may be available, or it may not be. In bone and South Carolina rock it is sparingly soluble; in the latter perhaps not at all.

Now, if you apply a large quantity of bone, it is slowly decomposed in the soil, and in this way plants get a partial or full supply according as the amount of bone used was large or small. But I do not believe in this method of fertilizing. I would use fertilizer in such a form that I could get the most of it back in a single year. Fertilize for the present crop, not for the next ten years. Fertilizers are the farmer's raw material. From them he manufactures farm products. Get the best raw material, and use it as quickly as possible. Turn fertilizer into crop, crop into money, and do it quickly.

The phosphoric acid in "slag" is in the so-called reverted form, and by some is said to be available for plants.

There are many who advocate cutting or fermenting bone with ashes, claiming that the phosphate of lime is made soluble by this treatment. I have had one of the chemists at our station in New Hampshire test this, and we find that there is no action of this sort, but the reverse; any soluble acid that existed was made insoluble. I would not advise any one to ferment bones with ashes; it is a poor practice at best.

Another reason why I believe in buying the crude chemicals (dissolved bone-black, muriate of potash and sulphate of ammonia, etc.), is that they are substances which contain plant food in an available form.

You cannot get insoluble nitrogen in sulphate of ammonia or nitrate of soda; the potash salts are easily soluble, and there is less liability of South Carolina rock being used in dissolved bone-black than in a mixed fertilizer. You exchange an uncertainty for a certainty in buying chemicals rather than prepared goods.

Again, with your nitrogen, potash and phosphoric acid in separate bags, you are at liberty to mix a fertilizer in any proportion that you find to be best adapted to your wants. I believe that each farmer should find out for himself what his farm needs. The experiment stations can do much to aid you, but you must adapt and adjust the work of the station to your own needs.

Corn and potatoes require different fertilization. I have found it not only without benefit, but positively injurious, to use nitrogen for potatoes. Now, it does not follow that this would be true everywhere, but in general it is so. Now, if every farmer here would try just the one experiment of planting potatoes on ground one half of which was fertilized with twelve dollars' worth of fertilizer containing nitrogen, and the other half with twelve dollars' worth containing no nitrogen, and would report the results, I have no doubt we could learn more about fertilizing potatoes in one year than will be learned in ten years. Now, why can't this be done?

You can buy the chemicals of any manufacturer of fertilizers, and you can mix them as you think best.

Each of the three materials are harmless to handle. They are as easy to mix as corn meal, shorts and cotton-seed.

The following is a corn mixture that I have recommended to our farmers : —

Dissolved bone-black,	325 lbs.
Muriate of potash,	100 lbs.
Sulphate of ammonia,	75 lbs.
Cost, about $11.00.	500 lbs.

This is for an acre, with no manure. Put 150 pounds in the hill, being very careful about letting the seed come in contact with it, and sow the remainder broadcast.

E. F. Bowditch of Framingham. This is food for how many bushels of corn to the acre?

Professor Whitcher. Well, that depends upon the land, whether it is corn land or not, and also on the season. On our farm it produced ninety-seven bushels of ear corn, forty pounds per bushel, and 5,352 pounds of well-cured stover; while the same land, with no fertilizer, gave forty-seven bushels of corn, and 3,266 pounds of stover; that is, for each dollar's worth of fertilizer the increased crop was worth $2.89, — a good showing.

Can Chemical Fertilizers take the Place of Farm-yard Manure?

I answer, unhesitatingly, Yes! Can I prove it, do you ask? I think I can. Not as fully as I might desire, but for four years I have had two acres of land under test for this very point. One acre had thirty-three dollars' worth of manure applied in 1885; manure charged at $3.50 per cord, — a low price. The other acre has had eleven dollars' worth of chemicals applied yearly, for three years; so that to-day we have applied just thirty-three dollars to each acre. Now, what is the result?

	Corn.		Stover.		Oats.		Straw.		Hay.	
	Manure.	Chemicals.	Manure.	Chemicals.	Manure.	Chemicals.	Manure.	Chemicals.	Manure.	Chemicals.
	Bush.	Bush.	Lbs.	Lbs.	Bush.	Bush.	Lbs.	Lbs.	Lbs.	Lbs.
1885, .	112	97	4,835	5,352	–	–	–	–	–	–
1886, .	83¾	82¾	4,435	4,927	–	–	–	–	–	–
1887, .	–	–	–	–	43	47.5	4,535	5,267	–	–
1888, .	–	–	–	–	–	–	–	–	5,880	6,202

Total value of four years' crops from manure, . . $169 19
Total value of four years' crops from chemicals, . . 174 72

The chemicals used yearly were : —

Dissolved bone-black, ...	346 lbs.
Muriate of potash, ...	150 lbs.
Sulphate of ammonia, ...	56 lbs.
Cost, $11.00.	552 lbs.

To apply the one lot of manure cost $2.80; to apply the three lots of fertilizer cost $1.50; difference, $1.30. Also, we have the interest on $22.00 for two years, and on $11.00 for one year, to add to this $1.30; this shows against the manure.

The hay on the chemical acre was full of clover, and I regard it as one-third more valuable for milk than the other.

Question. What was the soil?

Professor Whitcher. Clay loam. Connecticut River land.

B. P. Ware. One point, it seems to me, should be considered. This figuring is based on manure at $3.50 per cord; many of us pay five to six dollars. The difference in our case would be much greater than in the professor's.

Professor Whitcher. I would never apply more than 150 pounds in the hill, and would put that on top, after the crop is covered.

Combinations of Chemicals for Various Crops: amount per acre where no Manure is used.

WHEAT AND CORN.

Dissolved bone-black,	325 lbs.
Muriate of potash,	100 lbs.
Sulphate of ammonia,	25 lbs.

ENSILAGE.

Dissolved bone-black,	250 lbs.
Muriate of potash,	200 lbs.
Sulphate of ammonia,	50 lbs.

POTATOES.

Dissolved bone-black,	340 lbs.
Muriate of potash,	160 lbs.

OATS.

Dissolved bone-black,	300 lbs.
Muriate of potash,	150 lbs.
Sulphate of ammonia,	25 lbs.

GRASS.

Dissolved bone-black,	700 lbs.
Muriate of potash,	200 lbs.
Sulphate of ammonia,	50 lbs.

ONIONS.

Dissolved bone-black,	600 lbs.
Muriate of potash,	300 lbs.
Nitrate of soda,	100 lbs.

Adjourned to 1.30 o'clock.

AFTERNOON SESSION.

The meeting was called to order at 1.30 o'clock by Dr. Loring, who introduced Dr. E. Lewis Sturtevant of South Framingham as the first lecturer of the afternoon.

PARAMOUNT FERTILIZERS.

BY E. LEWIS STURTEVANT, M.D., SOUTH FRAMINGHAM.

Think science, talk practice. This is the aphorism for an instructor to ever bear in mind, as only correct thought can be expected to lead towards correct application, and science is the method of the arrangement of facts. Hence, in the pithy sentence of our introduction, we would express our sense of the duty of the lecturer towards his audience, his fundamental duty of stating facts in such orderly arrange-

ment that the teachings shall have reference to applied art, and shall presumably be correct in statement and application. I would also further express my views of an additional duty that devolves upon a lecturer at such a meeting as this; and this duty consists in stimulating thought in the hearers, by taking the audience into partnership as it were with the speaker, by expressing in words the thought and the science which leads to the practical talk which is expected by the audience. If, therefore, in a lecture which deals with the greatest of economical sciences, that of farming, the thought in the lecture takes precedence of practice, the audience must approve, as they consider that in practical success thought always takes this precedence, and that the interest in the practical conclusion necessarily must increase in accordance with the fullness and correctness of the thought which precedes as well as explains. I propose, hence, to think before you and talk to you.

My subject is not only one of practical import, but is also an intricate one, and hence, in order to keep within the bounds of the time assigned me, it will be necessary to use illustrative facts alone, and appeal to the consensus of tried experience for the securing of wider generalization. If, by implication, I also appeal now and then to the individual experience that shall confirm what science explains and scientific thinking here formulates, I may be pardoned in thus calling my audience into the exercise of that partnership in thought to which I have already alluded.

From Aug. 18 to Sept. 23, 1883, at intervals of a week, five corn plants at each collection, or thirty in all, were analyzed at the New York Agricultural Experiment Station.* The average result of these analyses offers a fair illustration of the composition of the corn plant at the period of its best condition. The figures of the analyses are: —

Water, ...	79.01	
Ash, ...	.81	of which { phos. acid, .08; potash, . .28
Albuminoid, . . .	2.06	= nitrogen, .33
Crude fiber, . . .	4.65	
Nitrogen — free extract,	12.92	
Ether extract, . .	.51	

* Report of N.Y. Ag. Ex. Sta. for 1883, pp. 153-155; 163.

These constituents can be roughly separated into two classes: 1st, Those removed from the soil; 2d, Those removed from the soil and atmosphere. The water and ash, or 79.85 per cent of the total, comes from the soil, as also some little of the remaining constituents. The carbon comes from the atmosphere directly, and is built up into the various carbohydrates. It is not necessary to our purpose to calculate the exact relations, but only to call attention to the fact that in the plant, *water*, which is taken from the soil, constitutes fully 79 per cent of the weight of the living plant, while the ash and nitrogen combined do not exceed 1.14 per cent, and the phosphoric acid but .08 per cent, and the potash but .28 per cent.

Transpiration in plants is the escape of aqueous vapor that has accumulated in the intercellular spaces, through the stomata of the leaves, and it varies in amount with the character of the plant, the moisture of the atmosphere, the intensity of the light, or the temperature, wind, etc.; or, in other words, upon those changeable conditions that occur between plants and their relations towards environment, which are principally, in turn, the relations which find expression in the concrete term climate. It is hence difficult to determine the *average* amount of this transpiration; but we can readily determine the amount of water thus given off by individual plants under given conditions, and can readily reach the conclusion of its enormous proportions and importance. Prof. Boussingault * found that in the case of the Jerusalem artichoke in a pot, each square metre of foliage exhaled hourly 65 grammes in the sunshine, 8 grammes in the shade, and 3 grammes at night. Wiesner † found that from 100 square centimetres of green maize leaf there were transpired in one hour: in darkness, 97 milligrammes; in diffused daylight, 114 milligrammes; and in sunlight, 785 milligrammes. In some experiments carried forward at Rothamstead, ‡ Sir J. B. Lawes reports that, from March 19 to September 7, the quantity of water given off by

* Popular Science Monthly, Jan., 1879, p. 365.

† Ann. de Sc. Nat. (6), 14, 1887. Goodale Phys. Bot., 278.

‡ Hort. Trans., 1850, p. 45.

various plants, under different circumstances of manurial application, were as follows: —

Each trial.	Grains.
Wheat, 3 plants, ...	55,996 — 113,527
Barley, 3 plants, ...	85,124 — 120,025
Bean, 1 plant (Vicia faba), . .	112,231 — 117,869
Pea, 1 plant, ...	96,405 — 109,082
Clover, 1 plant, ...	13,671 — 55,093

At a later date, in 1871, he reports * as a summary of results attained, that "in the growing and ripening of either graminaceous or leguminous corn crops, probably on the average from 250 to 300 parts of water are given off for one part of total dry substance, fixed or assimilated;" or, as summarized later by a writer,† that for every ton of really dry substance grown, a depth of three inches of rain would be evaporated through the vegetation; and this, let me remind, is for England, with its moist climate and sunshine of little intensity. Calculating from this data, we would have, in a corn crop of 50 bushels, a total yield of about 4 to 5 tons of plant, containing from 1,600 to 2,100 pounds of dry matter, which, multiplied by 300, — for the maize plant is a great evaporator of water, and the American climate is an intensely evaporative one, — represents a loss, through exhalation, of at least 240 to 315 tons of soil water per acre; or, as an inch of rainfall is equivalent to about 100 tons per acre, to an equivalent of from two to three inches of rain.

Returning now to our illustrative analysis, we find that of water and the other constituents usually reckoned as paramount in importance, viz., nitrogen, phosphoric acid and potash, our estimated crop of 50 bushels of corn, in its growing, removes from the soil, approximately: —

Water, ...	6,323 — 7901 lbs.
Nitrogen, ...	26 — 33 lbs.
Phosphoric acid, ...	6 - 8 lbs.
Potassa, ...	22 — 28 lbs.

Let us now review the extent of evaporation from the soil. In England, where, on account of the moist climate and rather equable temperature, the yearly losses through evaporation

* Jour. R. A. S., 1871, p. 93.
† W. H. Wheeler. Jour. R. A. S., 1878, p. 15

from the soil, either directly or indirectly, are comparatively uniform, they are usually estimated in considering the water supply of cities at from nine to sixteen inches of rainfall; in this country, with its drier and warmer climate, they are very variable, but are found on the average to equal about one-half of the rainfall; or say from fifteen to thirty inches of water.* The authority quoted, continues: "As illustrating the difference in capacity to absorb moisture of the atmosphere of the two countries (England and America), it may be stated, that the mean yearly evaporation from water surfaces was determined by six years of experiment at Whitehaven, England, to be 30.03 inches; while experiments lasting for one year at Ogdensburg, N.Y., showed it to be there 49.37 inches, and at Syracuse, N.Y., 50.2 inches. Observations taken at Salem and Cambridge, Mass., determine it at about 56 inches." In experiments with water surfaces at Plaistow,† England, the rate of evaporation was found to be 91.2 per cent of the rainfall, and trials at Dijon, in France, gave the rate as 96.6 per cent of the rainfall. At Orono, Me.,‡ evaporation from a water surface during the period from May 20 to October 17, was 18.54 inches; and at Milwaukee, Wis., from March 15 to November 14, as a five years' average, 32.58 inches.

From a soil surface, we have it stated by Dr. Dalton § as the result of observations during the years 1796 and 1798, in England, that the mean evaporation was 25.158 inches, and for the six months, April to September, inclusive, 16.788 inches, the largest amount being 4.095 inches in July, and 3.386 inches in August. Later, Mr. Dickinson ‖ determined the average evaporation from a lysimeter for equal years, 1836 to 1843, as 15.320 inches, or 57.6 per cent of the rainfall. Other foreign determinations ¶ are those at Rothamstead, the average of five years, 63.2 to 71.4 per cent of a 28-inch rainfall; those at Geneva, Switzerland, 61 per cent of a 26-inch rainfall; those at Orange, France, 80 per cent

* Report of the Cochituate Water Board for 1873, p. 11.
† Jour. of Agr. 2d ser., xii., p. 400.
‡ Fernald. Agr. of Me., 1869-75.
§ Mem. of the Lit. and Phil. Soc. of Manchester, v. pt. ii.
‖ Jour. R. A. S. 1856, p. 127.
¶ Scientific Farmer, Feb. 1878, p. 17; Feb. 1879, p. 15.

of a 28-inch rainfall. American trials have given the following figures as calculated for the Waushakum Farm lysimeter at South Framingham, Mass., from 1876 to 1878, inclusive: —

	Rainfall.	Evaporation.
1876, ...	43.88 in.	89.2 per cent.
1877, ...	43.22 in.	73.6 per cent.
1878, ...	54.36 in.	83.0 per cent.

or during the growing months, June, July, August and September: —

	Rainfall.	Evaporation.
1876, ...	13.98 in.	97.5 per cent.
1877, ...	9.40 in.	98 8 per cent.
1878, ...	15.08 in.	99.9 per cent.

The figures derived from the New York Agricultural Experiment Station lysimeters,* from Aug. 1, 1882, to Nov. 1, 1887, inclusive, show an average evaporation of 73.4 per cent of the 23.724 inches of rainfall, being 85.4 per cent from sod, 70.7 per cent from bare soil, and 63.9 per cent from cultivated soil. The average for June, July, August and September, growing months, was 84.04 per cent of the 11.84 inch rainfall.

From a few districts we have careful estimates of the evaporation which takes place from large areas under natural conditions, and such have been gathered together by Dr. S. M. Babcock,† as follows: —

WATERSHEDS.	Years of Record.	Rainfall, Inches.	Evaporation, Inches.	Evaporation, Per cent of Rainfall.
Lake Cochituate, Mass., .	29	49.11	27.03	55.04
Sudbury River, Mass., .	6	46.10	24.17	52.43
Mystic River, Mass., .	5	42.78	23.13	54.06
Croton River, N.Y., . .	13	46.64	20.29	43.50
Mean, ...	–	46.16	26.35	51.23

As Croton River flows mainly through a sparsely settled region, and the other watersheds are in a populous and

* Report of N. Y. Ag. Ex. Sta. for 1887, p. 397.
† Report N. Y. Ag. Ex. Sta. for 1887, p. 389, *et seq.*

cultivated region, the figures for evaporation may be considered as approximately similar for the several localities.

We may now review our scientific data, by stating the following propositions as approximately correct: —

1. The amount of water contained in one corn crop is 70 times that of the nitrogen and ash constituent, and amounts to about 79 per cent of the weight of the plant.

2. The amount of water transpired from one corn crop during its growth is equivalent, at the least, to from 2 to 3 inches of rainfall.

3. The amount of water lost from the soil through evaporation during the growing months is over 98 per cent of the rainfall at South Framingham, Mass., and over 84 per cent at Geneva, N. Y., as measured by the lysimeters; or allowing for surface drainage, which occurs on natural areas, is probably at least 100 per cent of the rainfall or more. For the year, from natural areas, this loss is over 50 per cent of the rainfall; as measured by the lysimeter in Massachusetts, about 82 per cent of the rainfall; at Geneva, N. Y., 73 per cent.

Passing now to practical data, which may wisely take the form of propositions, as being verifiable by common experience, we may note as of importance for our purpose: —

1. The variation of crop as between different years is far greater than occurs the same year between different fields differently fertilized, under conditions of fairly good farming, thus proving the importance to farming of the conditions generally included under the concrete terms, season and climate.

2. The variation in crop between different fields of similar treatment is manifestly dependent on the soil relations to moisture, as may be readily verified by careful and intelligent observation and trial.

3. The conditions of climate (or season) which principally affect the crop, as recognized yearly by farmers, is the greater or less amount of rainfall, as the farmer construes his observations; or, as the more observant man construes it, the distribution of the rainfall, and the extent of evaporation. (August, on the average, is the month of greatest rainfall, and usually greatest drought.)

4. In regions where there is less available water for the growing crop (not necessarily a small rainfall) there is found to exist the practice of more distant planting, and fewer plants to the hill, than where the conditions of water supply are more favorable. This may be illustrated practically by the 5 by 5 feet intervals and single plants to the hill practiced in the seaboard South, and the 3½ by 3½ feet intervals and four plants to the hill of New England practice, or experimentally by the following record of trial at the New York Agricultural Experiment Station,* 1882 being a dry and 1883 a moister season: —

CORN. Method of Planting.	Yield per Acre.	
	1882.	1883.
Hills 2 by 2 feet, 4 kernels to a hill, ...	7 bush.	28½ bush.
Hills 3½ by 3½ feet, 4 kernels to a hill, . . .	49¾ "	49½ "

The corollary from this table, which experience confirms, I shall digress to state as a fact, viz : That in Massachusetts, with a rainfall of 45 inches a year, it is as easy to grow one hundred bushels of shelled corn per acre, as at Geneva, N. Y., with its 25 inches of annual rainfall, it is to grow seventy-five bushels, and this irrespective of the fertility of the soil.

5. Weeds are great evaporators of water. By trial I have found that a weed crop may be absolutely incompatible with a corn crop, the corn crop showing in its curled leaf, stunted growth and yellow color indications of suffering from drought, and not bearing any merchantable ears. In the experience of farmers such evidence becomes graded, and can serve as a less intensified illustration than the one quoted.

The summary of this practical data is that crops, under circumstances of intelligent farming, are more dependent upon the water supply for their maximum increase than upon any other single agency.

* Report N. Y. Ag. Ex. Sta., for 1883, p. 137.

My audience will now discover that I class water as one of the paramount fertilizers, but before continuing I desire to caution that within the limits of an address I cannot present the whole evidence, or treat the matter as I would, and hence use but one crop, the maize crop, as illustrative. I propose to only go far enough here to excite interest and thought, and after making my propositions probable, proceed to the practical point of how to grow a crop under the best auspices for success; how to utilize this fertilizer which nature pours down and lifts up to each surface; how to retrieve from abundance to secure against the calamity of want. I would again remind that not only is water a component of plants, but it is a conveyor for plants, bringing to them matter in solution, which goes towards building up structure, and acts as a conveyor within the plant, so that we may say that it is the life, in the sense that we say the blood is the life. I would also remind that deserts are usually such, not from lack of elements of plant food, but through aridity, as is evidenced by the results of reclamation through the agency of the irrigation ditch or the artesian well in Algeria, our western plains and elsewhere. And, while digressing, I may as well remind you that all arable soil contains the fertility requisite for multitudes of crops, and that under artificial conditions under which water relations can be controlled, crops can be raised indefinitely, as in China, Japan, India, Palestine, etc. Where irrigation is practiced the average crop seems to have held its own for hundreds, even, perhaps, thousands of years of continuous culture under the trained art of native husbandmen.

It is now necessary to consider the movement of soil water, and in doing this I shall draw largely upon the data accumulated at the New York Agricultural Experiment Station, under my own supervision, and under immediate charge of Mr. E. S. Goff, the horticulturist.

As a general rule, the water content of the soil increases as we go downward, and the undersoil thus furnishes a grand reservoir of moisture which is available for the return of water to the surface through the action of capillarity, when not too remote, and when conditions are favorable. The great loss of water to the soil is through drainage and evap-

oration. The first is usually of little consequence for our present review, except in its absence, for cultivated soils should be well drained, either naturally or artificially. The second is of great import, as the loss through evaporation is greatly in excess of the loss through percolation (if percolation can be considered a loss to the crop), and this our figures heretofore given are sufficient to prove. We may state, however, that the water which flows from drains during the growing season in our climate is rarely the water of immediate rainfall, but that of displacement, or more usually that of the water-table, to which drains may be considered as standing in the relation of an overflow. At Geneva, N. Y., the water-table in 1887, as measured by the depth of well water from the curb (the well, happily for our purpose, being situated on a swell of land which carried the soil surface below the depth of the well bottom at a distance of a few hundred feet in each direction), was 4 feet $2\frac{1}{4}$ inches below the surface on May 1, 6 feet 10 inches on June 1, 9 feet 2 inches on July 1, 10 feet $5\frac{3}{4}$ inches on Aug. 1, 11 feet 3 inches on Sept. 1, 13 feet $4\frac{1}{2}$ inches on Oct. 1, and 15 feet $4\frac{1}{2}$ inches on Nov. 1, soon after which date the distance gradually decreased. This water-table was *unaffected by the rainfall* during the growing season. Capillarity, as measured by soil in tubes (a far less satisfactory way than in natural soil, but far more certain for experimental purposes), was traced vertically 44 inches, and probably would have extended farther had the experiment been designed for this purpose, but slight breaks in the column are apt to retard or terminate capillary progress. In natural soil, or bluffs along a shore, the base in contact with water, I have noted the effect of capillarity in raising water apparently a dozen feet or more. Horizontally the action of capillarity carries water more rapidly and farther than it does vertically. In nature capillarity brings an immense body of water to the surface, to be removed as aqueous vapor by evaporation, and in this manner, during some months, an amount of water exceeding the rainfall of the month thus disappears into the atmosphere. Evaporation is practically a surface phenomenon, and may be checked in great degree by any device that shall prevent capillary water from reaching the

surface. The lysimeters at Geneva, N. Y., had for surfaces, sod, bare soil, and frequently stirred soil. The first showed evaporation and transpiration combined, the second allowed the capillary water to reach the surface unchecked, the third had the capillary pores displaced by stirring of the surface, and thus retarded the flow of capillary moisture to the surface. For illustration we will quote the figures obtained. For the month of August, 1887, with a rainfall of 3.03 inches, in lysimeter No. 1, the sod, there was no drainage, all the water of rainfall, and more, being evaporated and exhaled, a good illustration of the drying influence of crops; in lysimeter No. 2, bare soil, the drainage was .695, leaving 2.337 inches of the rainfall as evaporated; in lysimeter No. 3, cultivated soil, the drainage was 1.055 inches, leaving of the rainfall 1.977 inches to be calculated as evaporated. Thus 2.337 inches, minus 1.977 inches, leaves .360 inches in favor of the cultivated area. This .360 inches means 9,775 gallons of water per acre conserved. In 1886, under different conditions of rainfall and climate, the difference between the two lysimeters was even greater, indeed enormous, and offers convincing proof of the efficacy of cultivation in conserving moisture at a time when moisture is most needed by the crops — it was 4.11 inches, or 111,607 gallons per acre; the rainfall being 2.86 inches. In 1885 the difference in amount evaporated between the hardened and the stirred soil was .208 inches, or 5,648 gallons per acre, with a rainfall of 5.02 inches. In 1884 the rainfall was 1.44 inches, the saving by the process of cultivation not indicated by our apparatus, as there was no percolation from either lysimeter, but in September, with its 3.17 inches of rainfall, the effect of cultivation was seen in the greater recovery of the stirred lysimeter from its extreme dryness and the saving of 6,707 gallons per acre. In 1883 the saving by cultivation for the month of August, with 3.47 inches of rain, was 10,671 gallons, and in 1882, with 2.37 inches of rainfall, was 11,948 gallons of water per acre. I offer these figures in quite full detail, as the importance of the saving is so great that I would impress the fact of the saving, and its possible enormous proportions, upon the minds of all, and having offered the explanations and the facts, I would enforce the

practical conclusion that cultivation, or the stirring of the upper layers of the soil, breaks capillary connections with the evaporating surface, and thus retards the loss of water and conserves the water for crops, which, as I have already shown, require a really enormous supply, and whose yield is dependent very largely on this supply. Cultivation is a mulch, and it conserves water, as our above figures show, and this is important to remember, much more in a drought than at other times.

Capillary action is exerted inversely in proportion to the diameter of the tubes or pores, and is stopped at once by a crack or space which interrupts the continuity of the capillary tubes or pores. Hence, in soil, the rate and distance of the action is regulated by the size of the pores in the soil and their abundance, and is checked by any loss of continuity. When water stagnates in the soil the earth particles are liable to come into close contact, the soil may become, if trampled, puddled, as we say, and hence the water of the soil may move rapidly towards the surface and disappear as aqueous vapor. This explains, in part, why undrained clay soil in cultivated fields suffers so severely from wetness in spring and drought in summer; this offers valid reason for the usefulness of drainage; this explains, in part, the apparent paradox that drained soil in summer often contains more water in a drought than does like soil that is undrained, a fact which at one, at least, of our experiment stations was considered so unorthodox that it became the subject of experimental trial and *was demonstrated.* In ploughing, the turned soil does not rest in close contact with the under soil until consolidation is effected by rains, etc., and the disturbed section gives of its own moisture to the atmosphere and regains but little from the stored water below. In the spring, when water is abundant and evaporation comparatively slight, no ill effects are perceived In the summer, however, with shallow ploughing, it is often difficult to secure germination of grass seed, or the continued life of the weak seedling, as the water from the disturbed soil is quickly evaporated and little additional supply can reach it by capillarity from the water stored below. The turning under of raw manure by the plough tends to form a strata discon-

nected from the surface compressed by the plough sole and the inverted surface. This is injurious to capillary action for a long period; and thus, during the dry season of the year, the ploughing under of raw manure is followed by a dryness of the workable soil which injures it for the reception of crops. This may be illustrated by the difficulty realized in securing growth of strawberry plants that are transplanted upon what is called a thoroughly prepared plot in August, or upon land to which rather long manure has been applied; and the success which follows such transplanting when, by means of a roller, or by trampling, the soil thus enriched or fined is closely compressed, and thus brought into close capillary union with the lower undisturbed soil.

The theoretical conditions under which, with proper climate, the best plant growth takes place, for cultivated plants at least, is the conjunction of the best physical condition of the soil as regards relationship to water, and the permeability to plant roots with sufficient fertility. Thus, in greenhouse culture, the florist cannot use soil that is loose in the pots; but he carefully compresses it so as to bring the particles into closer contact, and carefully avoids wetness during the process so as not to puddle his soil, and thus render it impermeable to roots and too evaporative of water; he uses a mixture with sand, and crocks below, in order to obtain proper drainage and permeability to water. He seeks to obtain those conditions whereby his soil shall never become unduly wet with stagnant water, never unduly dry, always permeable. In the larger culture of the garden and the field the same conditions of soil are desirable, although too difficult to regulate so perfectly. We can, however, by our processes and their proper timing, approximate sufficiently towards this condition to secure a gain.

We have thus far presented our illustrative facts, and the thinking whereby we have connected them in a measure with what we consider reasoned truths, adapted to practice and verification. We have, however, dealt with what may be called the mechanical consideration; but we would not have it inferred that this covers the whole field, for the chemical consideration also is of some large importance. Professor

Johnson,* in 1871, said that a German investigator found that when a small amount of plaster, common salt, sulphate of soda or nitrate of soda, was incorporated with the soil, the quantity of water evaporated by the plant was reduced, in some cases, more than fifty per cent; and when a free alkali, like potash, was added, the quantity was also very strikingly diminished. In 1850, Sir J. B. Lawes'† trials showed a striking difference in the amount evaporated by certain plants on mineral manure, mineral and ammoniacal manure, and on unmanured soil, as follows: —

KIND OF PLANT.	TOTAL WATER GIVEN OFF BY		
	Unmanured Plants.	Plants on Mineral Manure.	Plants on Mineral and Ammoniacal Manure.
	Grains.	Grains.	Grains.
Wheat, 3 plants, ...	113,527	98,006	55,996
Barley, 3 plants, ...	120,025	128,354	85,124
Clover, 1 plant, ...	55,093	53,723	13,671

These figures correspond with the German results as stated by Professor Johnson. But Sir J. B. Lawes,‡ at a later date, shows certain modifications produced by fertilizer upon the water relation of the soil. On the plots where nitrate of soda was employed continuously year after year, the soil apparently retained very much more moisture, and presented other interesting physical characteristics, differing from those obtained on adjoining land. In some experiments by Professor Roberts,§ at Cornell University, a mixture of salt and plaster was added to some soil in pots on July 11, and on August 16 the moisture in the soil was determined in the laboratory, with the result of finding increased water content in the soils to which salt and plaster had been applied. Other illustrative facts might be noted, and I think the observant person can readily adduce in-

* Ag. of Conn., 1871, p. 240.
† Hort. Trans., 1850, 45.
‡ Jour. R. A. S., 1871, p. 104; 1873, p. 370.
§ Proc. of the Soc. for the Prom. of Agr. Science, 1888, p. 60.

stances when salt or plaster or sulphate of soda or fertilizer has appeared to act beneficially as regards influencing the moisture in the land, always remembering that, unless the season be exceptionally dry, such observations can scarcely be successfully made. It is sufficient for my purpose here to simply call attention to this point.

I will but refer to the property that clay has of swelling when wet, and shrinking as it dries, by which it often so clogs the pores as to obstruct the capillary passage of water. The application of lime, or salt, or alum to water which will not deposit its sediment (settle), causes the clay to shrink at once and fall to the bottom; and it is believed that the application of these or other saline materials to clay soil often improves the drainage and capillary powers, by causing the clay to so shrink as to open the pores of the soil, when clogged, to the passage of capillary water. Professor Hilgard of California has well treated this subject under the title of flocculation.

We have now thought and talked science, a little discursively perhaps, as is becoming to the audience. We will now talk practice; and, in line with our preceding remarks, taking for our illustrative crop the corn plant, will put into plain form the information how we should grow, or attempt to grow, a crop, the maximum for the fertility present, and offer certain explanations as we proceed.

First, we desire well-drained land; the reason wherefor is that stagnant water is injurious to growth, and so also is overmuch water. Then undrained land (and this is very important to consider), especially if clayey, is apt to become puddled, as it were, and hence to dry excessively during the droughty season, as we have before stated. What the crop requires in soil, for its best development during the growing season, if I may make a distinction, is moisture, not water. Drainage keeps the water table from rising above the drains, and thus preserves the soil above the drains from all but percolating water of rainfall and capillary water supply.

Commencing with suitable soil, we would manure or fertilize broadcast, and plough shallow, for reasons which I have given in a previous lecture, to be found in the twenty-eighth annual report of the secretary of the Massachusetts

Board of Agriculture in 1881. The land should then be thoroughly harrowed, for the purpose not only of levelling and smoothing, but also in order to *consolidate the surface soil and bring the particles of earth into closer contact* (as the florists does in his pots by pressure), fill up the cracks and prepare for the next implement, which is the roller. This should be used thoroughly, *in order by its pressure to restore the capillary contacts* with the undisturbed soil below,* so as to secure the access of capillary water. These operations to be performed while the land is in a sufficiently dry condition not to puddle or cake.

Now plant your seed (under average conditions the earlier planted crop yields the best), the distances and quantities as enjoined by local experience, but in covering the seed be sure to either step on or otherwise compress the soil about the seed in order to secure close contact of the seed and soil. This not only aids to secure moisture for germination, but obliterates cavities in which mould can grow, to the destruction of the seed, and in early planted seed which is long in germinating, mould is usually very destructive. I will not speak here of seed selection and variety, or of the importance of good seed, as this matter has been sufficiently treated of by me elsewhere, and offers sufficient material for extended remarks.

At the season of planting there is always sufficient moisture, so the field can now be safely left, but in a condition, it is true, for great evaporative loss of water. As soon, however, as the plant attains the proper size, and the earlier the better, put in the cultivator and thoroughly stir the soil so as to break the capillary connections with the surface and prevent by the mulch of loose soil the access of water to the surface to be evaporated, and thus economize the water in the lower soil for future needs. Remember, a proper cultivation is irrigation! The succeeding cultivations can properly follow no definite intervals. The object is to conserve moisture, and hence *whenever through rain or otherwise the surface hardens and establishes surface connections to the capillary pores, put in the cultivator* and re-establish the mulch.

* A heavy rain after harrowing and before planting, or just after planting, is often of great service, doing the work of the roller, but more efficiently.

Get rid of the idea that the object of cultivation is directly to destroy the weeds and thus prevent their robbing the soil of the nitrogen, phosphoric acid and potash that they appropriate. The object in destroying the weeds is to prevent their robbing the soil of water, for this fertilizer robbery that has been so magnified by some lecturers can readily be offset by a few handfuls of extra fertilizer, but to replace the water thus lost would require barrels and team labor. After the ears of corn have commenced to glaze, even have just passed out of the milk, the requirements are dryness for the proper maturing of the crop, hence, the last cultivation can theoretically cease at the period when practical experience says stop on account of the obstruction caused by the large growth of the plant. At and after this period weeds may be of no disadvantage, but help dry the soil, and after the last of August, in this climate, with early planted corn, it is probable that the corn plant matures its grain from the material already stored within its tissues. Late weeds also act in part as a green crop to pick up nitrogen and conserve it against the percolating rains of autumn and winter, and this green crop, when ploughed under the following spring, is ready through decay to release this saved and stored nitrogen to the succeeding crop. In the Middle South and South the value of late weeds is such that in localities the sowing of weed seed at the last cultivation could be wisely recommended did not nature usually usurp the privilege from her abundant stores.

Following the plan of my essay, I may add parenthetically, as it were, that in raising the maximum crop which I have figured on, I would by preference use at least some artificial fertilizer, for the reasons offered, by which we may believe that chemicals have an influence upon the economizing of the water content of the soil, but, for the same reasons I have given before, I shall not dwell further upon this branch of my subject.

After this presentation I may rightfully appeal to the thoughtful intelligence of my audience to corroborate or deny the practical conclusions from their oft-repeated experience. Let the question be honestly asked, are these things true, are they properly noted, are the arguments valid, are they

in accord with an educated, practical common sense? If the answer is yes, then agree with me that my title is a proper one, that *brains* with *water*, and, as we all know, *nitrogen*, *phosphoric acid* and *potash* are the paramount fertilizers for the farmer; but the greatest of these is brains.

Mr. West of Hadley. I understand the lecturer to say that cultivation in a dry season preserves the moisture, but I do not understand whether when the ground is too wet for the crop, to cultivate or not.

Dr. Sturtevant. Leave the ground uncultivated, and the water will evaporate very rapidly from the surface. Take the vineyards in the western part of New York. You will find a difference of opinion among managers of vineyards differently situated. One man will argue very strongly the importance of leaving the weeds to grow in the vineyard; one will have the seeds of thistles among his vegetables, and at the same time he is combatted by others, who say you must keep the vineyard as clean as possible, and I feel there should be some circumstance which would reconcile their diverse judgments.

Mr. West. I did not understand whether you said late hoeing the corn was beneficial or injurious to the crop.

Dr. Sturtevant. I did not speak of it at all, sir. I spoke only of the first cultivation, the following ones to be governed by the condition of the land, and not by any definite empirical rule. In many southern states it is the practice, and recognized as a rule in cotton culture, to cultivate after the rain, always after the rain, and not at other times.

Mr. Augur of Connecticut. What is the idea of subsoiling? Has it any relation to drainage and cultivation, on tenacious soils?

Dr. Surtevant. Subsoiling appears to be a simple and local application. I have seen places where subsoiling was injurious when it was expected to be beneficial. I do not think the question permits generalization. Wherever subsoiling puts the land in the condition you want, it is beneficial; and if it does not put it in that condition, then it may be injurious. Without seeing or studying the soil, I could not speak in general terms in regard to it; but loose soil is not advantageous to any crop, and as all you gentlemen have experi-

enced in your gardens, that if you transplant a plant into land lightly worked up, you will find that plant will stand still for a long time, and will be of slow growth; and the gardener knows it so well that he always presses down the soil in his pot. Now, when subsoiling makes such soil, it is always injurious, as I have known any thing about it; but what we want is a close soil, not a loose one. It is a distinction not always recognized.

Mr. Ware of Marblehead. I would like to know how far this theory of the doctor extends. Some carry it a great deal farther than he does. I have heard it said that those who have observed the effects, think it is beneficial to their sparse land; that is, land of a gravelly nature.

Dr. Sturtevant. I think I can give one rule which will apply to nearly every possible case of that kind. Water which stagnates in the soil is extremely injurious, as every florist knows, and nearly everbody will know if he stops to think. When you have a soil, no matter whether it is clayey or sand or gravel, in which the water table rises to the surface and stagnates on the soil, then that soil is benefited by draining. Where the water table does not rise, then we have a natural drainage which offsets the necessity of artificial drainage.

The chairman then introduced Mr. J. D. Avery of Buckland, Mass., who read the following paper on "Profit from Sheep:" —

PROFIT FROM SHEEP.

BY J. D. AVERY OF BUCKLAND.

Mr. Chairman, Ladies and Gentlemen, — I will say at the outset that I was requested to treat my subject from a *practical* standpoint; this I will gladly attempt to do.

The interest in sheep farming, as the most of you are doubtless aware, has been sadly on the decline in this State during the past twenty years. According to the census of 1865 there were in this State at that time 160,997 sheep; in 1885 the number had fallen to 55,170.

The object of this paper is to create, if possible, a greater interest in this *neglected*, but to my mind, *profitable* branch of agriculture.

The first question which naturally suggests itself is, what

breed or kind of sheep shall we keep? For the average farmer, who must depend largely upon mutton in some form for his profits (since we cannot compete with the West in growing wool), any of the Downs, or their grades, will fill the bill if possessed of *individual* merit.

A grade Merino, if of sufficient size, makes a very useful sheep, shearing more wool, and being hardier and longer lived than the more open-wooled breeds. The pure-bred Merinos have sometimes proved quite profitáble, but they are usually too small and not milky enough for raising good mutton lambs. The long-wooled breeds are not so desirable for this section, as they require a rich pasture, with heavy winter feeding, and their open wool makes them unable to endure the exposure of our cold, wet storms.

The *size* and *make up* of the ewe for *general purposes* should count for *far more* than her breeding.

The ram should be pure bred; the particular breed will depend somewhat upon the purpose for which the lambs are intended. If early maturity is desired my preference would be in favor of the Southdown. If lambs are wanted for the fall markets, or the next winter's feeding, the use of a Shropshire or Hampshire-down would probably give you lambs of greater weight, and consequently more profit.

The best time to purchase sheep is whenever such as are desired can be bought at a fair price. The month of August is usually as good a time as any. Good breeding ewes can be bought for about four dollars each.

In making purchases leave the *old* ones for the *next* man.

The best plan for those who raise late lambs is to replenish their flocks by keeping a few of the best ewe lambs every year.

Do not allow your sheep to run out too late in the season, for, while they may look plump, the grass is so injured by frost that it will not furnish sufficient nourishment, and your sheep will surely run down unless fed a daily ration of grain.

House your sheep during the cold, wet storms of autumn, if convenient.

See that the fences are well put up before the sheep are turned to pasture in the spring. If they form the habit of getting out of a certain pasture it is not an easy matter to

stop them; but if those same sheep are moved to a pasture where they are not acquainted they will very often lie quiet.

A brush, rail, board, or wire fence, three or three and one-half feet in height, if made close enough, will usually stop sheep; but it will generally be necessary to top-pole a stone wall, even if it is four feet high. If sheep are not kept on both sides of the wall, the poles should not be placed over the centre, but towards the side on which the sheep are kept, this will make it much more difficult for them to climb over.

If fences are *properly attended to, and in season*, there will be very little trouble with unruly sheep.

Considerable has been said and written about the extermination of brush and briars in pastures by stocking them with sheep, some of which the writer of this cannot indorse. If any one thinks he can kill out foul stuff by stocking heavily with sheep, and at the same time keep his sheep in decent condition, without feeding them grain, he will get left; but this can be done successfully and profitably, when the pasture is not too far away, by feeding grain daily, thereby enriching your pasture, and at the same time ridding it of brush and briars.

Now in regard to the matter of sheep and dogs. Many are deterred from keeping sheep through fear of the ravages of dogs. I think this should not be so to any great extent. To be sure, the dog law is not what it should be. We need a law giving any one the right to shoot every dog found roaming at large without a keeper; but, since we cannot get such a law, let us make the best of what law we have, which provides a way whereby we can get fair compensation for all sheep *killed*, *maimed*, or *worried*.

If the selectmen or appraisers do not award sufficient damages, appeal to the county commissioners; and, nine times out ten, they will do the fair thing by you. It is a very rare thing for a selectman to appear before the board of commissioners and oppose the claims of a person who has appealed from his award.

Now, we come to the very important matter of winter care and management. This, it will be necessary to vary somewhat, according as the ewes are expected to lamb early or

late. If not due to lamb before April, good, fine, early cut hay will be all the feed your sheep require until near lambing time, when a small ration of grain, consisting of corn, oats, oil meal and wheat bran, will be beneficial. On the other hand, if you wish to feed a poorer quality of hay they will need a small ration of grain from the time they go into winter quarters. Right here is the stumbling block to some, in the way of success. They somehow get the idea that sheep can be wintered without grain and upon food which is unfit for any other stock; and, acting upon this theory, it is no wonder that when spring comes and finds twenty-five per cent of their flock dead they give up the business in disgust. It is useless to expect *something* from *nothing*, but I claim that there is no stock to which we can feed poor hay in connection with grain and get as good returns as from sheep.

Give your sheep dry sheds, with plenty of windows for light and ventilation. One very important item is to keep the air pure and fresh at all times; this will require close attention and a good deal of ventilation on warm days.

Provide them with pure running water if possible, to which they can have access at all times. The amount of water which a ewe that is suckling a lamb will drink is astonishing.

See that the water-tanks are kept clean; especially will these need looking after during the spring, for the sheep and lambs will start for water with their mouths full of grain, some of which will be dropped into the water, and in a few days of warm weather it becomes putrid, making the water unfit for any thing to drink.

Feed hay three times a day, and be sure that you are regular in the time of feeding, then your sheep will soon learn when to expect their feed, and after eating will be quiet until time to feed them again. If the hay is fine, feed them no more than they will clean up. Should the hay be very coarse, what is left by the sheep, being freed from dust, will make good feed for horses, especially those that are inclined to be heavy.

Let one man have the entire charge of the flock if possible, and don't allow strangers to go among them, unless that man is with them.

The manure made by sheep (especially those which are fed grain), makes one of the very best fertilizers, producing a rank growth of any crop, and being very lasting in its effects.

I will now make a few suggestions to those who are engaged, or are about to engage in the early lamb business.

In the first place, be sure to use nothing but the best of pure bred rams, and as I have said before, my preference is for the Southdown; the best are the cheapest. To illustrate this, I will relate something which came under my own observation. A few years ago a man with whom I am well acquainted, bought a flock of fifty sheep in the month of November; they dropped their lambs during the months of December and January. He did not know what the sire of these lambs was, as the sheep came from a distance; but they were not first-class, being long-legged, with thin back and light quarters. The next year he used a Southdown ram, and the lambs from these same ewes were no more like those of the year before than a Durham calf is like a Jersey for veal purposes, and when ready for market were worth one dollar per head more. This may be an extreme case, but it will illustrate the point.

Feed your ewes a gill of grain a day, commencing when they come to the barn, and if you wish to feed them meadow hay and the like, give them a half pint or more.

When yeaning time comes, you will have but little trouble if your ewes have been well fed and cared for up to this time. They will have an abundance of milk, and will be almost certain to own and care for their lambs. It is *poor feed* that makes *poor dams.* The lambs will be strong, and in nineteen cases out of twenty, they will get up and suck without assistance in ten or fifteen minutes from the time they are dropped.

Should a lamb in any way get badly chilled take him to a warm room and give him half a teaspoonful of brandy with a little milk and put him into a pail of quite warm water for five minutes, then rub him dry and roll him in a hot blanket, and when he has slept off the effects of his potations he will be ready to take his rations in the natural way.

When the lambs are about two weeks old their dams

should have an abundance of early cut hay and rowen, and their grain ration should be gradually increased to a pint and a half or a quart, consisting of corn, oats, oil meal, cotton-seed meal and bran in equal parts by measure, to be given in two feeds, the prime object now being to produce as large a flow of milk as possible.

The lambs must have a pen into which they can go at all times, and into which their dams cannot go. In this pen put a little rack and a trough, and feed them the very best of early cut, fine rowen and all the grain they will eat, which will be a very small amount until they are a month old, and will seldom exceed at any time a quart each per day. Their grain should consist of one half old process oil meal and the balance mostly cracked corn or corn meal, with a very little cotton-seed meal; there is nothing which they like better than cotton-seed meal, but it should be fed sparingly.

Have the troughs made in such a way as to prevent the lambs from getting their feet into them, and if there is any grain in them in the morning clean it out before putting in more. Keep the lambs growing every day until ready for market. If they get a setback they will never fully recover from it. The aim should be to force them along just as fast as possible, for the younger they can be made to weigh sixty pounds (which is the standard) the better price they will bring and the less it will cost to raise them, consequently the greater the profit.

One advantage in raising *early* lambs is that it affords a way to dispose of old sheep, and any others which it is not desirable to keep for breeding purposes. My practice is to put all such sheep in a pen by themselves, and feed them all the grain they will eat; then let them go to market with their lambs; or, perhaps, a little later, they will usually bring enough, with the wool on their backs, to buy the same number of good young ewes after shearing.

The most common way of disposing of early lambs, in our section, is to sell them to dealers, who take them at the nearest railroad station.

Another way, practiced by a great many, is to send them by a commission dealer. Probably those who are near the city markets can dispose of them to better advantage by selling direct to the butchers or marketmen.

Each one must decide for himself which is the better way. My practice has been to sell if I could get a satisfactory price, otherwise send them. I have never had occasion to send more than one lot, and got more for them than I asked the dealers.

The average price of good, early lambs is not less than $7.00, and of wool 20 cents per pound, in the dirt.

I will now give you a few figures, and then you can judge for yourselves in regard to the profit from sheep. For convenience in reckoning we will take ten ewes and figure as follows: —

Dr.

To cash paid for ten ewes,	$40 00
" three tons hay at $10.00 per ton,	30 00
" cash paid for grain,	20 00
" hay and grain for lambs,	10 00
" service of ram,	2 50
" summering ten ewes,	7 50
" losses, estimated at five per cent,	2 00
Total expense; the manure balancing the labor,	$112 00

Cr.

By ten ewes at $4.00 each,	$40 00
" ten lambs at $7.00 each,	70 00
" sixty pounds wool at 20 cents,	12 00
Total receipts,	$122 00
Deduct expenses,	112 00
And we have a balance of	$10 00

This statement is a moderate one. Some do much better and get eight and even nine dollars per head for lambs, which would make the balance thirty dollars instead of ten dollars. On the other hand, some who have had a large experience claim that sheep can be kept for considerable less than the above estimate. This, of course, would make the showing still better.

Now, if there is any truth in these figures, is not this branch of agriculture deserving of our careful consideration? This question will apply especially to those who are raising scrub steers and heifers at an actual loss, when they might, by raising lambs, get a good "profit from sheep."

Mr. ——. Mr. Chairman, there is one thing that I would add, and that is, that the manure in the sheep shed is packed so tightly that you can leave it as long as you choose without danger of its heating. This is quite an advantage.

QUESTION. In feeding lambs, do you feed them fine or coarse food?

Mr. AVERY. I do not usually have mine ground fine. The oil meal which I have is usually cracked. Sometimes, instead of cracked corn, I give them corn and oats ground together, or cracked corn mixed with whole oats. The sheep I usually feed with whole corn.

Mr. CLAPP of Easthampton. I would like to know the most convenient method of feeding sheep, whether in mangers or racks, or any other way.

Mr. AVERY. My method is to feed the hay and grain in the same rack; the bottom of the manger or rack is close for feeding grain. Some have a sort of trough at the side for feeding grain.

Mr. HICKOX of South Williamstown. How many can you keep together profitably?

Mr. AVERY. I do not usually keep more than twenty-five or thirty in a pen together. I have had fifty or sixty, and even more in a shed together, with only a partition between.

Mr. HARDING of Deerfield. For years the theorists have told us that all you need to do is to turn sheep into a poor pasture and make a strong fence around it, and the sheep are coming out fat. Now, any one who has kept sheep knows better. It is a fact that a few sheep may be kept in a poor pasture where you would not think of turning in anything else, and they will do tolerably well; but sheep want good feed, and they will pay for it as well as any stock we have. Three tons of hay for ten sheep is a liberal allowance. I think it is full as much as they will eat with their grain, and perhaps more.

Mr. LYMAN of Southampton. I would like to know whether sheep turned into flush feed will do as well as when the feed is fed short.

Mr. AVERY. I should prefer not to turn them into flush feed. I think it best to turn them out in the spring, when the feed is short.

Mr. PARSONS of Southampton. Is there any advantage or disadvantage in keeping cattle and sheep in the same pasture?

Mr. AVERY. I think, perhaps, the sheep will get the best of it. [Laughter.]

Mr. EDWARDS of Southampton, County Commissioner of Hampshire County. What is the fair average price of sheep in Massachusetts? When sheep are destroyed by dogs the selectmen prize them all along from four dollars to ten dollars, and sometimes as high as twelve dollars.

Mr. AVERY. Well, I should say four dollars a head. I do not think that the sheep in our town are appraised, on an average, by the assessors at more than that. Mine are not.

Mr. BOWDITCH of Framingham. I would suggest that the value of a sheep that is killed by a dog depends entirely on the time of year, and whether she is safe in lamb. The value of the lamb, with the proper amount deducted for its keep, ought to be added to the value of the sheep; and, according to Mr. Avery's statement, four dollars, which is very moderate, would make it eleven dollars. If it was later in the season, and had on four or five pounds of wool, that ought to make a difference. His price is four dollars just after shearing.

Mr. AVERY. Yes, sir. I will say, in regard to all my statements, that I intend to keep within the limits of average experience.

Mr. SESSIONS. I hope the audience will understand Mr. Avery's estimate is four dollars a head when he starts with them in August.

Mr. HARDING. I think Mr. Avery has put the price low, rather than high. I know a year and a half ago I had an order to get fifty good young ewes at six dollars a head to deliver, and I could not get them.

Mr. SEARLE of Northampton. I noticed that when the gentleman came to balance his books he said nothing about the item of the care of the sheep.

Mr. AVERY. Yes, sir. The manure balances the care, and that is very good pay. I would like to take care of them for the manure if somebody would find the feed.

Mr. Clapp. I lost sheep for which I was awarded five dollars a head. I went to Buckland to find some to replace them, and I could not find any short of six dollars apiece. Within two or three weeks men have been travelling about the country to find breeding ewes, and could not find anything they wanted short of ten dollars.

Mr. Bowditch. Mr. Chairman, I would like to say that, from my experience, and from what I have learned in cases of damage to sheep by dogs, I think the general feeling with the selectmen is to give a liberal award. I have heard of very little complaint. I believe the public generally are interested in the advance of agriculture in our State, and that for the encouragement of sheep keeping they are willing that the authorities should make very liberal awards for damages done by dogs. The public recognize the fact that one object of the dog tax is to provide money to pay for stock killed or worried by dogs; and as the dog fund is abundant, damages should be well paid for. This should be so, for it is very discouraging to have the prospective income from your flock cut off by a raid of dogs.

Mr. Taft of West Upton. After some eighteen years' experience in appraising damages, I find the price awarded by the selectmen seems higher than the price at which sheep can be bought, and I asked one how that happened, and he said, "when a sheep is killed by dogs they always select the best one in the flock." Looking the matter up pretty closely, I came to the conclusion that he was correct. They go for the one that is ahead; and the best sheep are always leaders. I think the disposition of the selectmen is to make a fair appraisal. But, after all, Mr. Chairman, I came to the conclusion that a man whose sheep were damaged by dogs did not get paid, if they attack sheep when they are in lamb. If they half kill the sheep it is good for nothing. The damage to a flock by worry of the sheep is much more than is supposed. I suppose the dogs in my section of the State are worse than others. You can not raise sheep in Worcester County. In my town there are fourteen sheep. I think in the town of Grafton, where they used to raise quite a number, everybody has gone out of the business. They are worried to death by dogs. Every man pays two dollars. It

makes a pretty large tax for dogs, but it is paid freely; yet keeping dogs is death on sheep. I was down at the Vineyard two years ago. They can raise sheep there, as they have no trouble with dogs. I found sheep there four or six miles from any habitation. But we are overrun with dogs, and it useless to think of our raising sheep. You may raise them in Franklin County, but you have got to exterminate the race of dogs, or they will exterminate the sheep. A friend of mine in Sutton said they had some very nice flocks there — rams they paid fifty dollars apiece for — and the first thing the dogs took was the ram — the best one. I think there is one man there that has been raided six times this season. A friend of mine was driving along, and a dog came out and took his horse by the nose, and it did him damage. His wife said, "You will get paid for that." "No," he said, "I have got two dogs just as bad." I have some neighbors that keep more dogs than they do anything else; but they do not feed them; somebody else has to do that. I would like to have a law passed authorizing anybody to shoot a dog if running loose without a keeper. [Applause.]

Mr. Peterson of Green Harbor. I would like to ask some gentleman who is interested in the raising of sheep what the best fence is to keep the dogs out and the sheep in. That may help solve the sheep problem in a measure, at least for those who would like to keep a few. I would like to keep eight or ten myself, if I could do it safely, for my own use.

Mr. Avery. I would not want to undertake to build a fence to keep the dogs out; but I do not have much trouble in keeping the sheep in.

Question. What about the new method of fencing? What about the barbed wire? Will the dogs go through that, if it is high enough and thick enough?

Mr. Bartholomew of North Blandford. I have no doubt that dogs do work mischief, but we must remember that there are varieties of dogs as well as sheep. In our section we have no better protection for our sheep than our dogs; but we keep thorough-bred collies, and when they are well trained they are the best protection that we have for our

flock. I have one myself, and if a stray dog gets after my sheep, he is after him pretty soon.

Mr. Clapp. Will a dog brought up with sheep kill a sheep? I have always had a dog, and never knew him to attack a sheep.

Mr. West. That depends upon the kind of dog. I have had both kinds, those that would kill, and those that would not.

Question. I would like to ask Mr. Avery's experience with dogs?

Mr. Avery. I have never been troubled to any extent with dogs until last year. I had some eight or ten sheep, out of perhaps three hundred, that were killed. This year I have had no trouble with them at all.

Question. That is all the trouble you ever had?

Mr. Avery. Yes, sir.

Question. No wonder you keep sheep, then. Do you keep a dog?

Mr. Avery. No, sir; never owned one.

Question. Do your neighbors?

Mr. Avery. No, sir; not the near neighbors.

Question. Do you have plenty of hunters round?

Mr. Avery. Yes, sir; they are quite plenty.

Mr. Lyman of Southampton. I was about to ask a question in regard to fattening sheep; whether it is any advantage to grind corn for that?

Mr. Avery. I do not think it is. I do not think it pays the cost.

Mr. Lyman. Do you not think it would pay to grind for lambs?

Mr. Avery. Well, in our section we do not practice grinding corn for lambs; we crack it.

Mr. Lyman. Don't they prefer the corn unground?

Mr. Avery. Yes, sir; and they will select the coarser parts first. They seem to like to grind it themselves.

Mr. Abbey of Palmer. I would like to say a word with reference to food for sheep. I do not know of anything so profitable and economical for winter food for sheep as good corn ensilage. Any one who has breeding ewes, and wants a food that will produce milk, should use corn ensilage.

You cannot grow roots at the same cost that you can produce ensilage. Lambs eat it at a very early age, and will thrive on it.

Our experience this year has proved that dogs go for the best sheep. The first week in September a dog went into the pasture and caught the best buck lamb in the lot, a thorough-bred Shropshire; he was worth twenty-five dollars. We sent our bill to the Selectmen for twenty-five dollars. They said they would settle it for twenty dollars, because that was the limit they were allowed without any appraisal. We took the twenty dollars, whereas it was a loss of thirty dollars to us. We sent off and got another one for twenty-five dollars, and did not get so good a lamb.

I would like to give a little report here of a flock of sheep which I had in 1886. Sixteen sheep in January cost $65; lambs sold from this flock, $80; wool, $16; fifteen ewes sold in September, $67.50; one sold at another time $7; total receipts, $170.50; cost of sheep, $65, — leaving a balance of $105.50, for keeping the sheep from the early part of January to the middle of September the same year, 1886. In September, 1886, I bought a flock of fifteen sheep for $67.50. The following June I sold lambs, $84; wool, $20; other receipts, $57.50; fifteen sheep valued at $67.50; receipts, $171.50, — leaving a balance for one year of $106. In 1888 sheep have done equally as well as they did before. I have an account of another gentleman. I know the facts to be as stated. December, 1887, ewes cost $24; sold six lambs, $36; other items of receipts and expense left a profit of $45. These lambs were some of them only ten weeks old, and weighed sixty-three pounds, for which the owner received twelve cents a pound; some of them came to seven dollars apiece.

Mr. Rowley of Egremont. I would like to add a word in regard to dogs. I noticed what the lecturer said in regard to shooting dogs at sight. It seems to me that does not cover the ground. The attack on sheep has generally been in the night time and unseen. Six weeks ago I went to a pasture to get my sheep. I found three dead sheep, two more that were nearly so, and eight more that were bitten. I called upon the Selectman that lived near by. Well, the

result is, I shall send every single sheep of that flock to the butcher as soon as I can fatten them. The flock that I have been raising for some years is spoiled. When I was on the board of selectmen we always put into the appraisal of sheep the worriment of the flock, as near as we could get at it. It is impossible to get it accurately. When on the board of commissioners, if that question came up, we meant to be fair; as has been stated here, the general sentiment in western Massachusetts is to be fair. It has come to this, either the sheep must go or the dogs; now, which is it? [A voice, "dogs."] I say so, too. It is but a few years since I bought a nice flock of thorough-bred Southdowns. I paid eighty dollars for a yearling buck; I paid two hundred dollars for ten ewes, just imported, and I paid for four more $125. I had not had those sheep at home two weeks before I was aroused one night by my own dog in the horse-barn barking. The buck and a few ewes were near the house, and the buck was only bitten on the side, and that passed off. In less than a week the dogs were in three flocks the same night; and, in one flock of seventeen, thirteen were killed. It broke up the flock entirely. Well, I tried that for a few years, and I found it unprofitable on account of the dogs; I either had to keep my sheep shut up nights, or else watch them. I had had no sight of the dogs. I then disposed of the Southdowns and commenced with Merinos. If I cannot grow sheep for mutton I will grow them for the wool; and that is what I am doing now, and it is a step down. Several of my neighbors are doing the same also. It has come to the pass that we must give it up or must have some way to control the dogs. Now, shooting them at sight is well enough if we can catch them at it; that is impossible in the night. I would have the dog tax made ten dollars instead of what it is now. The trouble spoken of here is not from the class of dogs that guard the sheep; it is a mongrel dog that generally comes from the city. A thorough-bred dog I never knew to attack a sheep, unless he was led off into bad company; and I believe a tax of ten dollars, and that law enforced, would go further toward increasing the number of sheep than anything else, and I do not believe there is anything wrong in it. The persons who

keep these dogs that kill sheep are generally irresponsible, pecuniarily, when you trace them out. They are not people to pay the damage, if they were prosecuted, and unless steps of that kind are taken, why we must abandon sheep raising.

Mr. Hickox of South Williamstown. I am glad this subject has come up to-day. I have had the same trouble in our own section. The hills in western Massachusetts used to be covered with sheep, four hundred and five hundred in a flock; but to-day we find no sheep in our town. The men who used to keep sheep have their pasture idle; they are paying taxes on it, and are struggling along with their farming, and getting no benefit from it; and, if you ask them why they do not stock the pasture with sheep, they will tell you they are afraid of dogs. The dogs are here, the dogs are there; and must we give up the sheep industry on account of the dogs? I think this is a question worthy of being considered, and that we should not go away from here and forget it, but should see that there is a remedy provided this coming winter to protect the men that want to grow sheep in our State, but dare not for fear of the dog.

Mr. Avery of Spencer. Speaking of dogs, our town was overrun with dogs some few years ago, and farmers were making bitter complaint on account of their losses. At the annual town meeting we voted to increase the tax to three dollars, and it had a great effect in clearing out the little yellow dogs. It had the effect of reducing dogs in our town more than fifty per cent. I do not know whether we had any legal right to do it or not; but we did it, and have collected it. [Laughter.]

Dr. Sturtevant. I have a friend who is extremely ambitious for foxes. He was a sheep keeper, and used to expose strychnine among the sheep to kill foxes; and he said, "you would be surprised to see how many dogs I kill." It is a matter of taxation, because I think the dog owners have some rights; and, in a Democratic region or Republican region, we ought not to put on a tax which is oppressive to the poor man and not to the rich. But I think if the suggestion of the society be modified to allow all dogs to be killed, not shot, when found on your own property, the result would be good.

Mr. Bowditch. If we are not getting too far from the subject of sheep, I would like to say I have spent a good deal of time through two sessions of the Legislature on the subject of the dog law, and I can assure you it would be impossible to procure any great change in the present law, on account of the very strong feeling among the majority of people about dogs. There is one thing that we have learned, that in agriculture we have new weeds and new bugs for every new crop we grow; but in some way we get the best of the weeds and the bugs. Now, I would have the sheep inclosed securely. It is more trouble, and it costs more, but it is very seldom a dog will jump over a picket fence, particularly in the dark. I have kept three hundred to four hundred sheep the last three or four years; sometimes six hundred or seven hundred; I hurdle most of them at night, and I have had, during the ten or twelve years that I have kept sheep, two ram lambs killed; and I assure you that, in the town of Marlborough, which is a shoe town, we have as many dogs as any town can boast of. It is the care and watchfulness in keeping sheep which is needful to make them pay, as it is in any other farm crop or farm animal we try to raise. It will be some expense, in an outlying pasture, to hurdle at night; but if you have a large flock of sheep, it will cost but a trifle per head.

Mr. Taft. I am opposed to dogs; but I believe it to be impossible to accomplish anything by trying to amend the dog law, there are so many men who keep these dogs. I think only about two years ago a man found a couple of dogs with his sheep, and one of them was shot. I happened to be upon the board of selectmen. I found the dog that was killed. It was a shepherd dog, and somebody is going to feel very badly when he learns his dog is killed. It turned out that those two shepherd dogs came from eight miles away from that pasture. You could not have bought either one of those dogs for one hundred dollars. One of them was owned by a man who had just died. I do not suppose his widow would have sold the dog at any price; she had the feeling that the dog was part of the family. It is so throughout the State. It is not that class of dogs that generally do the damage; it is the mongrel dogs. Mr. Bow-

ditch says you can hurdle the sheep. If he can hurdle them, that is all right; but farmers upon these hill-town pastures would have great difficulty in doing it. If you want to raise sheep and make it a success, as he does, you must have large farms, and have a large number of help; but where some of us do not keep much help, the dogs beat us. But still I agree with him, that, with the present state of feeling, you cannot pass a law that is much more stringent than the one you have now.

Mr. Grinnell of Greenfield. It is hardly worth while, perhaps, to say anything more on the question; but I am going to give my testimony. I had the honor to be in the Senate as the representative of the farmers of Franklin county, and Gov. Long said to me, "Why do you not make a law that will give you the protection you want?" I said "it is utterly impossible." We prepared an amendment to the present dog law. We could not make a new one; but the amendment was so simple that I had every expectation it would pass, and I supposed that would be the first entering wedge toward changing the law. The provision was, first, when the injury had been done to a flock, the county commissioners should pass upon the testimony about it at the first meeting they had, and not as now, in December.

Mr. Bowditch. It has been changed. It is all right now.

Mr. Grinnell. Very well. It won't hurt my story at all. That was one. The other was simply to the effect, that when a dog was known to have killed sheep, the owner of the dog should be prosecuted,—the county commissioners should be obliged to prosecute that man for the value of the sheep destroyed, and cause the dog to be killed. It is the simplest thing in the world, and the county commissioners can do it, but I do not think they ever did in this State. I got those two amendments through the Senate, which is the worst place in the world for such things, because it is farthest from the people. But when it went into the House of Representatives, of all the scenes that were ever enacted, those took the prize. A man got up and opposed the law, a Boston lawyer, a dog-breeder; and one, I am happy to say, who afterwards skipped the State on account of em-

bezzlement or forgery, and has never been back since. He attacked it; talked a great deal without touching the question; said "the idea of killing a pet dog!" And he pictured it in such a way that those fellows sat there with tears running down their cheeks. Men went in there with the intention of voting for this amendment. They were told how the wife and children would feel if their dog was killed, and they could not stand it. Women came into the committee rooms with their little dogs. Mr. Angell, the president of the Society for the Prevention of Cruelty to Animals, met us and blocked our way every time. He thought it a wicked shame that dogs should be killed; but a few years afterwards he changed his sentiments, so that now he is one of the most violent anti-dog men.

I like to have Mr. Bowditch give us his advice, and we will follow it as well as we can; but in his great pasture, with great breeding dogs, a mastiff that can chew a little dog up, and with a man ranging round the premises with a double-barrelled shotgun, of course he can do better than others who have not such facilities.

Mr. Lyman. I imagine that the difficulty of sheep raising in the hill towns of western Massachusetts is not so much on account of dogs as on account of the difficulty in keeping sheep in your own pastures. The abandonment of so many farms in our mountain towns has left a large tract of land open; and, by travelling over the hill towns in the purchase of sheep, I find that is the greatest trouble. They do not complain so much of the dogs as that there is no place to confine the sheep, and so they have abandoned the keeping of them.

Question. I would like to inquire if a person that loses ten or fifteen sheep is obliged to find them all before he can recover damages for them? He knows they are gone, and he finds five, but the other five he cannot find. The selectmen say, "We shall not pay for the sheep you cannot find." I know one man who hunted three days, but he could not get pay for part of his sheep, because he could not find them.

Mr. Augur. Mr. Chairman, I have been very greatly interested in this paper and the discussion of it I think it is

exceedingly practical. I wish to allude to just one point to which I think the speaker did not allude, which is an important one to those who keep sheep, that is the time of shearing. Years ago there was an old adage: —

> "If you shear sheep in May,
> Shear them the last of May;
> Shear them in June, —
> You can't shear too soon."

Well, sir, in the latter part of my experience in keeping sheep, I made the rule to shear the first of May, and found it decidedly the best; and then if we had a cold storm I would keep them shut in. In regard to dogs, we find in Connecticut that the average agricultural society awards more premiums to dogs than it does to sheep. It always seemed to me that this is going in the wrong direction. Well, Connecticut is hardly a wool-growing State now. The business has been driven out by dogs; and they not only attack sheep, but also cows, and horses, and calves. A short time ago I heard of a registered Jersey heifer, worth one hundred dollars, that was so bitten as to be virtually spoiled. I do not know but the owner can get damages; but I rather doubt it. I do not know that their law applies to anything but sheep. But, in regard to the award by the selectmen, I think the rule has been in Connecticut, that, while they get the mutton value of the sheep, if a sheep is specially valuable for breeding purposes, they do not get satisfactory damages. We find the average selectmen are not willing to give liberal damages in the matter of fancy or high-priced sheep. But we have in Connecticut, as you have in Massachusetts, sheep in some of the back towns. We have a great deal of land that is going to waste, and we might keep thousands of sheep where none are kept.

There is one point I want to allude to — a practical point. There came very near being a syndicate formed in Middlesex County, Conn., in which I live, for buying up three or four continuous farms, and making a sheep ranch, inclosing it with a barbed wire fence. I should hope that the idea would be carried out; for it does seem that where there is a considerable tract of good sheep land, which might be put

together and fenced by a good barbed wire fence, there is about the most practical protection of sheep I can think of. In Connecticut the worry the owner has when a dog does extensive damage in a flock almost always leads him to sell out his flock and give up the business. I know of but one man in our town that attempts to keep sheep.

Mr. Sessions. The object alluded to by the last speaker is just what led to the selection of this subject. There are so many thousands of acres in New England, which are practically running to waste, it would seem that sheep might be utilized; and I was hoping that we might get something from this discussion bearing upon the matter; and we have got something from it. In regard to this matter of damage from dogs, I have had a little experience which illustrates this trouble that sheep owners have—and I think one thing we shall see is the creation of a public sentiment toward awarding proper damages for killing and maiming sheep. I had a flock of say sixty sheep, and about the middle of November the dogs got into them and killed fifteen, and two were missing. The flock were as tame as any cossets you ever saw. My man could go into the field and lead them from one field to another, or home and back again; but after this happened he could not get near them with a salt dish. The sheep were wild, and the moment they saw a movement they ran away; and they have not got over it yet, and won't get over it. The chairman of the selectmen was called. He had been a sheep owner. He chose two men, among the best in town, farmers, owners of sheep, to come and appraise the damage, and they considered it. They asked me at what I valued the sheep. I said the whole flock at six dollars a head; but the best ones were killed. I do not know why it was; but it was the fact. Well, they looked it over, and finally concluded to appraise the fifteen sheep that were gone at five dollars and fifty cents apiece, which they thought would be about fair. The two that were missing they did not know were killed, and they could not appraise them; and, if they should prove to be dead, why, they thought five dollars a head was about a fair price, and the excess would partly make up for them. Now, one that was missing has been seen, but nobody can get anywhere near

her. I got five dollars and fifty cents for those that were found and nothing for the worrying of my flock.

I had another experience with a chairman of selectmen who is not a farmer. Dogs got among my sheep, and a sheep had a lamb about half grown, and the dog bit the sheep badly. The lamb I never saw. You can imagine what became of it, but the lamb was gone and has never been seen. The chairman of the selectmen came and said, "I can pay you damage on the sheep, and if you can prove the lamb was killed I can pay you for him." Well, I got nothing for the lamb. There is the trouble. The sentiment of the State ought to be in favor of giving a sheep-owner under these circumstances abundant damage, and I believe it is. The law is for the protection of sheep, not for the sake of taxing dogs. The real object is the encouragement of sheep-raising. I think the sentiment of this meeting ought to influence the chairmen of selectmen and the public generally to do the fair thing by sheep-owners. [Applause.]

Mr. West. My own experience happens to be something like this: The middle of September or first of October the dogs will get among my sheep and drive them out of the pasture. The fences are good enough if they will leave them alone; but if a dog gets in there, the sheep will jump a fence four and a half feet high, and will run right into my mowing. Can I put them back and keep them in the same pasture? No, sir; it is almost impossible. They have got a taste of that fresh feed, and they will get it. It is impossible for me to get any damage, yet it is a damage to have those sheep get in there, and I think other people must be damaged in the same way.

Mr. Cruikshanks of Fitchburg. It occurred to me while Mr. Augur was speaking about the plan that had been talked of in Connecticut for inclosing a large territory for keeping sheep, to mention the system they have in my native land, in Scotland, where shepherds are employed. It would be very much cheaper to employ shepherds to herd the sheep than to inclose three hundred, six hundred or eight hundred acres in these hill towns to keep sheep.

Mr. T. S. Gold of Connecticut. I assure you I have an interest in this matter of sheep and dogs. I would state

that this morning I mailed a blank circular to be filled out with statistics upon the question of the number of sheep killed by dogs in the State of Connecticut, and the amount of damages, and various other inquiries with regard to the number of dog taxes enrolled in each town. I mailed them to every first selectman in the State of Connecticut, requesting a prompt return to me, that I might have some exact statistics and facts upon that subject in the State of Connecticut; so that you see I was interested in this subject of sheep and dogs before I came here to-day.

I have been exceedingly interested in the discussion which has taken place here. The very complete paper presented here is simple and straightforward, and commends itself to every one, and I would emphasize some of the points in it While I do not believe sheep can tackle briars and bushes and destroy them when the field is overrun with them, yet there is no other means within our reach by which we can control many of the noxious weeds that now infest our New England fields We could better afford to pay something for the use of a flock of sheep, when we want to eradicate the white daisy, the ox-eyed daisy, the wild carrot, or some other of those weeds. Sheep will not eat all kinds of weeds, but some kinds are a choice morsel for them, and nothing can be used so effectually to destroy them as a flock of sheep, so that we must give the sheep credit if we keep them, and one of the arguments for keeping them is their assistance in cleaning out pastures. If sheep are turned out early and kept there until the first of July, in two years they will clean a daisy pasture so perfectly that you would not recognize the field at all; and the good grasses, the finest grasses and clover, will be encouraged to take the place of the comparatively small-producing daisy.

Mr. Bowditch. I will indorse that.

Mr. Gold. This question of the dogs and the sheep is a very troublesome one, and the best solution we can make of it is to induce the farmers by some means to keep more sheep. I believe that where sheep are kept in considerable numbers, where there are a number of flocks about the neighborhood or in a town, they are very much less liable to ravages of dogs than where there is only a solitary dozen

sheep kept in the town. In towns where there are only a few sheep kept, according to the statistics, they will surely become food for the dogs; but in a town where there is a considerable number of sheep kept, there is less trouble. I have always been a keeper of sheep, and my neighbors own sheep, and always have. Well, I have had one or two wholesale raids into my flock within my memory; but the last six, eight or ten years I have not lost a sheep by dogs. Some of my neighbors have lost some. I think that the farmers shelter themselves (they are lazy and procrastinating in their habits in regard to putting up their fences) under this belief that it is dogs that prevent them from keeping the sheep. I believe if they will rouse themselves to the importance of saving these old pastures, and making them worth something for keeping other stock in (and I consider the sheep as helps in that direction), and will put the fences in condition so that they can keep the sheep where they ought to be kept, and not starve them on these old pastures, that they will overcome this difficulty, and we shall hear less complaint that it is the dogs. But how can you expect, when nine men out of ten in the community own dogs, and only one man in fifty, or a hundred, owns sheep, that we can get these dog owners to tax themselves any more for the benefit of the sheep owner than they are taxing themselves now? I think we had better hold on to what we have in that direction than to risk losing what we have by attempting to get more. There have been a great many points brought up here of exceeding interest to me, and well spoken of. The speaker recommended cotton-seed meal as a food for sheep. I have had a little suspicion in regard to the effects of it upon a flock of ewes, and still I have no positive facts, you may say, to condemn the article; but, after feeding this more freely than I ever did before, I had the worst luck with lambs the succeeding springs, — fine lambs, at two weeks old, suddenly dropping off and dying without any provocation at all. I attributed it to having fed them with cotton-seed meal, and I have refrained from using it since. I consider it a very strong, stimulating food for sheep or milch cows, and in the case of such cows there is danger in using it. It is the most dangerous feed our hired men feed on the farm,

in my opinion; and I would advise cautiousness in regard to breeding sheep.

Mr. SAGE of the "Homestead," Springfield. I believe, if we are to bring about the salvation of our hill towns, it is more by the use of sheep than in any other way; and I would like to ask Mr. Cruikshanks whether it is not practicable to employ trained shepherds, with trained dogs, to watch the flock. Suppose a syndicate should buy up a thousand acres of Berkshire land, and fence it, and also provide a competent shepherd, and make him responsible for the flock,—what do you think of that?

Mr. CRUIKSHANKS. I should say, in answer to the question, that I have had no experience in the matter. I left my native land before I was old enough to have anything to do in that way; but I have read a great deal about it, and I can distinctly remember seeing the shepherd driving his sheep, with his short petticoat, plaid over his shoulder, Scotch cap, and dog by his side. I can remember distinctly all that; and it may be in the memory of some how the late Richard S. Fay brought a Scotch shepherd to this country to herd his sheep at Glenmere, near Salem. I went to the place and saw Mr. Fay at the time, and likewise the shepherd. It is the practice in Scotland, and it is the only way that sheep can be kept there, because they have no fences. On those large mountain ranges, sheep are herded in that way by the shepherd and his dogs. One dog is worth a dozen men. A dog understands just as well by a simple word what direction to take, and he will bring the sheep all together into an inclosure. One thing may be interesting to this audience, and that is the test of a good shepherd dog. There are prizes offered in Scotland for shepherd dogs. Their trainer takes ten or a dozen sheep, and puts them into a pen full of sheep. The prize is offered for the dog that will go into that flock and pick out his own sheep in the shortest time. A man with such a dog can herd sheep on the mountain side.

Prof. H. E. ALVORD. While at Houghton farm I employed a shepherd for the care of a flock of sheep ranging from two hundred to four hundred in number. Sheep for mutton, and early lambs should be kept out throughout

the pasturing season, put out early and kept out late on unfenced hills. In Orange County, New York, just back of West Point, there were no fences at all, or nothing worthy of the name, and the sheep were cared for by the shepherd and his dog. Beginning with early spring, it was necessary for the shepherd to remain with the sheep most of the day. As the season passed on he could leave his flock for a greater length of time each day, leaving them in charge of the trained dog, who remained with the flock. The most of the season I think the shepherd was a milker. He started out his flock with the dog, and remained until after the milking, and then followed his flock; saw it in his pasture in safe condition, and left it again for an hour or two in the middle of the day. We were not far from the city of Newburg, within a few miles of several pretty good sized villages and towns. There were plenty of dogs, and small sheep raisers in the same locality have more or less trouble with dogs; but in five years I had but one visitation of that flock, and that was when both shepherd and dog were absent. I think there were none killed, and only two or three lambs bitten in the leg and rear. The shepherd is the guardian of the flock; but nothing less than a flock of three hundred would justify the expense of the shepherd, and of course there would be a greater profit when the flock was increased to four hundred or thereabouts. But I have no question in my own mind as to whether the suggestion of Mr. Cruikshanks is a good one. The cheapest way of caring for a flock of sheep is with a shepherd and dog. Part of the time we had a dog so well trained that the shepherd was unnecessary during the entire day. The dog would take the flock to the pasture and remain with them throughout the day, and bring them back to their fold. One dog will take care of four hundred sheep.

Mr. Sessions. If we do not figure the profit higher than the essayist did, we should have to have a pretty big flock if we are going to keep a shepherd.

Mr. Sage. We all know that sheep cannot be profitably raised near a city where hay is worth twenty dollars per ton; but we know we can find good sheep land within fifty miles of this place for five dollars an acre, where hay can be bought

from seven to ten dollars a ton, — good sheep hay. I contend that such lands could be used in a practical and profitable way, if a man who understood his business could be placed in care of the sheep. I am acquainted with parts of Berkshire county where the land is good. It formerly kept the owners in affluence. To-day, because of the western fever, etc., the territory is almost depopulated. I know of no reason why people who come to places like Lancaster and Pittsfield should not go a little south and west and make the hills bloom again. I do not look on farming with sentiment; but, where money can be made with sentiment, I say let us do so; let us improve those old hill towns.

Mr. Sessions. It is said it will cost too much to fence this land. Now, 160 acres can be fenced with wire, if you run the wires on the trees, for $160, and for a square mile only twice as much, or fifty cents per acre.

Question. How many wires?

Mr. Sessions. Four wires.

Question. Will four wires turn dogs?

Mr. Sessions. I think so; but another wire is only just a fifth more. At present prices of wire, the material to fence a square mile with four wires would cost $253.50; with five wires it would cost $304.20. Provided you can put it on trees, as you can in many places, it will cost but little to string it. Now, the fence problem is wonderfully simplified by barbed wire, and the gentleman who thinks he cannot afford to fence the pasture has not investigated the matter, as it seems to me, especially if he has got any trees where he could hitch the wire. The essayist has had a good many years' experience in keeping a large number of sheep, and I would like to ask him, if he went into anything of this kind, whether it would answer to keep a thousand sheep together. If we should buy up a large piece of land and put sheep upon it, a thousand or two together, would such a large flock do well together?

Mr. Avery. I think they would do well; perhaps not as well as they would in small flocks. I never had more than a hundred in a pasture together. I do not see but they do about as well as where only a small number are together.

QUESTION. Would not two thousand sheep in a pasture separate themselves into flocks of a healthy size?

Mr. AVERY. I think they would, naturally. I want to say a word in reply to the gentleman who thinks that one dollar a head is pretty small profit. Now, it seems to me, if we can get one hundred cents on a dollar for all we pay out for grain, and if we on the hills can get ten dollars a ton back for hay fed in the barn, and pay for our labor, and then have a dollar a head left, it seems to me it is pretty good business. The estimate which I gave you was at seven dollars a head for lambs. There are many which do much better than that. I have myself sold one hundred lambs for nine hundred dollars; and those lambs were raised from ninety sheep, which would give a profit of between two and three dollars a head, instead of one.

QUESTION. What does it cost to keep a ewe sheep for a year, — from the first of May until the next first of May, — and have her grow a lamb, feed her well, and a lamb which at twelve weeks old would weigh sixty pounds?

Mr. AVERY. I think it was three dollars for hay and two dollars for grain for the winter.

Mr. GOLD. It would be just one-tenth of your estimate on ten?

Mr. AVERY. Yes, sir. My estimate for the ten would be seventy dollars — seven dollars a head.

Mr. ——. Why I asked the question was this: I have a friend in Franklin County who makes a business of raising early lambs. He has his sheep lamb in December and January, and he says he can keep his sheep from the first of May until the first of May, and get pay for his hay at four dollars a head; and he has sold his lambs for years at eight dollars.

Mr. AVERY. I have allowed in my estimate three dollars for hay through the winter. I have hired sheep kept through the winter for one cent per day, which would be not much more than half the amount which I have allowed.

Mr. SESSIONS. The essayist has done just what I wanted to bring out here — what a practical man can do; and he has shown that he can make one dollar a head on his sheep.

Mr. PETERSON. There is one matter to be noticed — the danger that attends the keeping of sheep in large numbers,

and the diseases which they are in the habit of having where they are kept confined. They huddle together much like our poultry; and I have found in poultry the larger the flock the less profit. And, though I have no practical experience in keeping sheep, it occurs to me there must be considerable danger from various diseases to which they are liable in keeping them at certain seasons of the year without proper ventilation. I should think that might be brought out in a few words.

Mr. AVERY. I have never had any trouble from those diseases.

Mr. SESSIONS. The essayist urged that they should have plenty of air and plenty of fresh, clean water.

The CHAIRMAN. He said that he fed them well and kept them clean.

Mr. AVERY. I once heard a man ask another who had had considerable experience in sheep raising, what was the best thing to prevent grub in the head. His reply was, "plenty of grub in the stomach." I think there is a good deal in that.

The CHAIRMAN. I have had a good deal of experience with sheep, and a great deal of observation. I undertook at one time the breeding of Merino sheep, not in accordance with the high ideas of Vermont men, but as a practical thing; and I secured a flock of two hundred and fifty Merino sheep of good Vermont people, which fed on a pasture within a mile and a half of the city of Salem. The pasture is very admirably adapted to sheep-growing and sheep-feeding. I found that it was very difficult for a man to succeed with that class of sheep unless he was remote from the town, and unless he understood thoroughly well the wool market; for the increase of Merino sheep for the mutton and lamb market was so inconsiderable they could hardly be counted. I have studied the business in Vermont. I used to go to see a great raiser of American Merino sheep there. With regard to the price of sheep, he once made to me an interesting statement. As I went into his field, he had perhaps a couple of hundred beautiful ewes, and he had in an adjoining pen eight or ten rams. Anybody who has seen his flock of sheep will remember what a charming object it was. The shape

of the female was perfect, and their thrift and condition were as fine as any flock I ever saw. He said to me, "I have just lost a young ram which was gored by an ox, and I was offered the day before I lost him, eight thousand dollars for the ram." I said it was a great loss. It was in the height of the merino fever, I should say in 1864 or 1865. He said it was; "but," said he, "that lamb cost me three dollars." Now, you can judge what it cost to raise a lamb in that State. He was a careful and accurate feeder, always kept his sheep in the best condition. He was in Vermont, where hay and grain were comparatively cheap. I state that fact to answer the question put by the gentlemen who asked the cost of keeping sheep. The cost differs according to the locality, according to the place where hay has a market value, and where grain is of value.

Now, I think the business of sheep husbandry may be carried on profitably. I think so because the essayist says so; and, if that is not a good reason, I would like to have some other reason and a better one given me. He has just told me that the sheep business is the main business of his farm, that he has a flock of two to three hundred sheep. He has told you that they are middle-wool sheep. He says that he pastures some of them twelve or fifteen miles away from home, and on a farm of three hundred and fifty acres he makes the caring for two hundred and fifty sheep a profitable thing to him. Now all I can say to the farmers of Massachusetts is, what one man can do another man can do in the same locality, or in an equally good one; and, if the essayist is not a specimen of a successful and wise farmer, I would like to have the people bring up one that is. [Applause.] I consider him a pretty good-looking agricultural youth in the State of Massachusetts; and, as he was reading his essay, I remarked to the secretary he was a specimen of the kind of farmer that I want to see all over this Commonwealth. [Applause.] And I think he is entitled to that compliment for the presentation of the sheep question in the way he has done it; and, when he says he has kept himself in the condition he is in, and got his farm in the condition it is in, and that he has done it with a flock of two hundred and fifty sheep, with the addition of a small amount of cattle which he pastures in the summer season, buying in the spring and

selling in the autumn, I think if anybody wants to know anything about sheep industry, he had better go to Mr. Avery's farm and stay there until he has learned his lesson. But we cannot all do that. Sheep husbandry is a good thing as an adjunct to the farm. A farmer may not be able to keep one hundred or one hundred and fifty sheep, but if he is so located that he has protection against dogs, the addition of sheep is always a good thing. It shows he knows how to use his refuse hay, and that he is always sure in the spring of the year of getting a little income from his sheep and lambs that have not cost him a great deal of personal labor. It is not like milking a cow, and feeding and cleaning her. He is always sure of getting a little revenue from his sheep and lambs, which is so handy to pay the taxes which are sure to come in at that time. I think the sheep husbandry stands where Mr. Avery puts it. And let me remind you, wherever you see a first-class small farmer with a good home, a good barn and nice outbuildings, you will be pretty sure in the outlying regions to find that he has got a little flock of sheep. Whether it is the taste or the thrift, or what not, I have always found in these days, and surely in the older times, that a few sheep always constituted an addition to a farm that a wise and good farmer would always have. So I would say, let us take heart on the sheep question. If you want to go into it, go and learn a lesson from Mr. Avery. If we want to teach it to the farmer, let us study the habits of our ancestors, who always kept sheep in addition to the cattle. The farmer's work is of such a nature that every opportunity should be improved, and all its strings pulled for the profit of the owner.

Now, gentlemen, pardon me for putting in my wisdom on the sheep question; but I have studied it carefully, and the advantage of it is just about what I have stated to you. Mr. Sessions has reminded me over and over again that it is time to adjourn, and I have resisted him until I can resist him no longer. I want to say, as I must go to Boston to-morrow, I have enjoyed this meeting amazingly. It has reminded me of the old time when I used to meet with the Board fifteen years ago and twenty-five years ago, and it seems to me I am returning to my youth.

This meeting will now stand adjourned until 7.30 o'clock.

The evening session was held at 7.30 o'clock, when, owing to the illness of Mr. Wheeler, who was to have spoken, President H. H Goodell gave his lecture advertised for Wednesday evening. It is thought best, however, to print the lecture of Mr. Wheeler in the place assigned to it in the programme of the meeting.

LIFE IN JAPAN.

BY WILLIAM WHEELER, LATE OF THE AGRICULTURAL COLLEGE, SAPPORO, JAPAN.

In one of those curious and delightful legends of the fabulous age of Japan, a mythical forecast of her recent history has been traced.

Amaterasu, the sun goddess, was the eldest heir of the mythical pair by whom Japan was created and peopled. Her younger brother, *Susanoo*, the god of the sea, was brave and powerful, but turbulent; and, being fond of hunting, he wantonly cast over her and into her sacred abode the reeking products of his chase, and otherwise defiled her dwelling. Angered by his rudeness, she indignantly withdrew, hid herself in a cave, and closed the mouth by means of a huge rock called the "stone gate of heaven;" and, her face being hid, night and day were the same; darkness and distress prevailed.

To entice her forth, the eight million gods or genii met in counsel on the banks of the "river of heaven" (the milky way), and, consulting together, devised a plot. Some piped before the mouth of the cave, others danced, and still others played fanciful antics to tempt her forth, while *Tajikaro* ("great strength"), the god of strength, was posted in ambush hard by. The sounds of revelry touched her curiosity; and, tempted to see the sight, she pushed the massive stone ajar and peeped out.

The stratagem succeeded. "Great Strength" at once clapped his hands, stamped his feet, braced himself for a mighty effort, and seized and threw down the massive door, while the gods drew her forth, and passed a slight but effectual barrier behind her to prevent her return. Naturally enough, it does not appear that she resented the audacity of the gods; on the contrary, she resumed her place among them with evident satisfaction.

Now, by an easy reach of imagination, in place of the mythical sun goddess, put historic Japan She became known to the Western world just fifty years after Columbus discovered America. The naval and commercial marine of Europe, — of Portugal, Spain and Holland, — in the sixteenth century was god of the sea, adventurous, and inclined withal to be somewhat aggressive toward a weaker though elder sister. Annoyed and perhaps alarmed by the harrassing inroads of these rovers of the deep, and at their efforts to cast upon her domain the unwelcome product of their trade, as well as religious and political contaminations, she withdrew in high dudgeon nearly a century later, and for two hundred years secluded herself from the rest of the world. The cupidity of the outer world was in the meantime more keenly incited thereby, but vain were its attempts to allure her forth.

But now the modern god of strength, American civilization, had quietly but firmly posted himself close by the rocky gates of her retreat, and in 1854 the artful caresses and novel divertisements of our gallant commodore (Perry), together with music of the world's activity without, strains of which oft reached her ear, excited that keen curiosity so marked in her character, and she warily pushed the diplomatic door ajar and peeped out.

Again the stratagem prevailed. The "great strength" of our day threw open the gates, Japan was brought forth from her seclusion, and her retreat from the community of nations cut off by a barrier of cross-character treaties. Brought thus suddenly into unsought relationships, doubt and hesitation soon gave way, and she became not only willing, but eager, to join in the race of modern progress.

That this legend is generally supposed to explain, in the light of Shinto-mythology, the wonder-exciting phenomena of a solar eclipse, does not impair the aptness of the comparison. The children of the gods who now people the "land of the sun" have emerged from a national eclipse, the recurrence of which no political astronomer would venture to predict.

With the main features of Japan's wonderful history most of us have perhaps become tolerably familiar, through the

various sources of information which have come to hand during the past fifteen years. The fanciful mythologic period which extended from "the beginning," through ages during which the gods alone existed, to the creation and peopling of Japan by them, followed by a national chronology, whereby the present dynasty of rulers antedates the Christian era six hundred and sixty years; the imbibition of Chinese literature and civilization, which began about three centuries after Christ, and the introduction of Buddhism two hundred and fifty years later; the dual empire of the Mikado and Taikun, which existed for nearly seven centuries preceding the reign of the present emperor; the early concession of commercial privileges to Europeans, especially the Dutch and Portugese; and the labors of the Jesuit missionaries in the sixteenth and seventeenth centuries, terminating in the wholesale persecution and extirpation of foreigners and their converts; the system of rigorous feudalism, and the closely drawn lines of class distinction among both nobility and people, which characterized the whole of her historic period; the exaction of treaty relations by the United States in 1854, followed by similar concessions to the European powers; the overthrow of the Shogunate or Taikun's power, and the restoration of the Mikado to sole civil and military supremacy in 1868; and the new departure of the government in its ardent pursuit of modern arts and sciences, — these are the leading points of her history, and have become a part of the general information.

With this topical review, therefore, of the past, I shall assume that you are prepared to appreciate the significance of such random sketches of the social, industrial and political life of her people as I am able to recall from the three or four years of busy life which I spent among them.

The true origin of the Japanese race is a problem which still awaits solution. To the Malayan, Mongolian, the African, and even the Caucasian or Indo-European families, either singly or by combination, their origin has been attributed by different writers. That, as Griffis claims, they owe anything to the blood of their historic aborigines, the Ainos, who show some evidence of Caucasian origin, seems to me

altogether improbable. Physically and morally, in habits, and so far as we can learn in language, they are quite distinct; while, to this day, intermarriage, in any form or degree, is not known to occur between them.

The Japanese physique is not prepossessing. The men are small, narrow-chested and lank. Their heads are of medium size, covered with black hair, usually straight; and the high cheek bones, large, coarse mouth, inferior nose and irresolute chin, though not universal, are noticeably characteristic. The French have a saying, "His face was carved with an axe." It does not inaptly fit the Japanese face. Their hands are of finer mould than their features, which fact, considered in connection with that aristrocratic obliquity of the eye which they admire, helps one, if I mistake not, to know the leading traits of their character.

The women are quite small, and of full, rounded figure. The nose is short, lips full and inexpressive, and the neck painfully slender. While young, and not given to the offensive but fortunately vanishing customs of blackening the teeth and shaving the eyebrows, they are not altogether unattractive, while their easy grace of manner, pretty gestures and musical voices, constitute undeniable charms.

The Japanese countenance lacks expression. The features brighten in conversation, however, and lighten amazingly with a smile. The people age rapidly from early youth, the average period of their efficiency being shorter by ten or fifteen years than is that of Europeans.

Their extreme politeness is proverbial. In the typical Japanese it even suggests a distortion of character, since it becomes vastly paramount to sincerity. Said one of their officers who travelled much with me: "Foreigners speak very plainly, and I always know what they mean. A Japanese is very polite with his tongue, but you do not know what he thinks in his heart."

It is not unusual for literary travellers the world over to estimate the traits and character of a people upon the most brief and limited acquaintance. The wider the divergence between the superficial and fundamental in national traits and character, the greater the error of such conclusions; for the superficial not only impresses the ordinary observer more

readily, but it is essentially misleading. These facts underlie many erroneous conceptions of the Japanese which numerous writers have held.

For my own part, for nearly a year I looked upon them with unqualified admiration. I was exceedingly busy, had acquired but little of their language, while the officials whom I met fairly showered me with kindness. During that time I hardly heard a baby cry; did not know the fumes of *sake* (rice whiskey); could not distinguish the unstable gait of a man on his clogs from the rolling stagger of another in his cups, nor a toper's wine song on the street at midnight from the incantations of a wandering priest, and heard the insidious truth from foreign teachers and missionaries, with the mental reservation, "as a man thinketh, so is he."

Nevertheless, during the further period of my life among them, it became my lot to know the people under the greatest variety of conditions and circumstances. I came into more or less intimate relations with all classes, from the prime minister and former *daimios*, down through official and private grades, to tradesmen and coolies; spent months in their capitals, and in the interior in places where a foreigner had rarely, if ever, been before, sometimes with officials and servants only, at others with my wife, where certainly a foreign lady had never travelled. I knew them as a friend enjoying their full confidence; as a teacher of students whose ambition and sympathy were mutual with his own; in an advisory relation to a department of the general government; as an engineer and director of public works, involving the labor of sometimes a thousand men; and, last but not least, as a housekeeper. For the result, I think I came to know them as they are; and, while it demolished certain Utopian conceptions, it brought them in my mind within the brotherhood of our common humanity, and into fellowship with the rest of this wayward, yet onward and upward moving world.

Thackeray says that men and women are to be represented, not as men and women are known to be, but with certain reserves to suit conventional etiquette. I avail myself of such reserve, not to evade the truth, but to indicate, in admissible terms, in which direction it may be looked for.

While Miss Bird, who has given us a most accurate picture of Japanese life, boldly tells her readers that the prevailing faults of its people are lying and licentiousness, she is compelled to admire their many good qualities. They are, indeed, an incongruous people, but their character is full of compensations. Whatever its unpleasant features, you may not look far to find corresponding bright ones.

One exception to this rule is a sin of omission common to most Eastern races. I never found a parallel virtue that adequately compensated Oriental procrastination. Impressed by its dire associations, the merest novice soon learns the Japanese word *mio-nichi* (to-morrow), the time when everything is promised to be done, yet even then is not, that should have been done to-day or yesterday.

Early in my travels in the interior, I overheard my interpreter, whom I had directed to order our horses for seven o'clock next morning, instruct the driver in this wise: "The horses are to be ready to-morrow morning at five o'clock." I admonished him, saying we ought not to give orders the fulfilment of which we did not propose to exact. The following evening, at the close of our day's journey, he said that he had ordered the horses to be ready the next morning at seven o'clock, *foreign style*. "Seven o'clock, foreign style," he said, "means seven o'clock, sharp. Japanese style, any time during the day."

The people are generally tasteful in their attire and surroundings, although some of their customs do not conform to our ideas of neatness and propriety. They wear no linen or underclothing.

The principal garment, the *kimono*, worn alike by both sexes, is a loose, flowing gown of cotton or silk, reaching the ankles. It has large, bag-like sleeves, through the upper part of which the arms pass, the bottom hanging as low as the waist, or lower, making huge bags or pockets, in which they carry handkerchiefs, usually of paper, and often used more than once, early writers to the contrary notwithstanding.

The garment is made throughout of one roll of cloth, which they weave in breadths of about thirteen inches, each piece containing the precise quantity required for one

kimono. It is cut only into suitable lengths. All the long seams, therefore, are straight and selvaged, and are loosely sewn. When at long intervals, if at all, it is to be cleansed, the seams are ripped, and the plain breadths of cloth are washed and stretched by simple adhesion upon a smooth board, which they place in the sunshine, whereby the drying and ironing are completed in one operation.

Around the waist the *kimono* is bound by the *obi* or girdle, the second in importance of the various articles of dress. It is in the form of the *obi*, and the elaborate dressing of the hair, that the differences between the ordinary costumes of the two sexes chiefly consist. It is generally made of heavy brocaded silk, about four inches wide for men, and twelve to fifteen inches for women. It is wound three times around the waist, and as much skill and taste is displayed in tying and adjusting the knot behind as our belles exhibit in dressing the hair. It is said that gallants and connoisseurs can distinguish between Tokio and Kioto ladies by the difference in their manner of wearing the *obi*.

I was further informed that the *obi* serves a purpose unlike that of any garment worn by ladies of any other land. Widows who have determined never to marry again publish their resolution by wearing the knot in front. Doubtless there were young widows in Japan during my stay there, but I never saw this evidence of self-abnegation. However, it is the privilege of ladies to change their minds, most fortunately, perhaps for some of us, and it is said that even there the knot has an irresistible tendency to backslide.

In full dress an additional outside garment shorter than the *kimono*, but otherwise similar, is worn by both sexes, but more frequently by men, who wear also the *hakama*, or loose trousers of similar material. This garment is made with wide vertical plaits, so full that upon a casual look you would take it to be a kilted skirt. It is in truth a "divided skirt." The prevailing colors for both sexes are sombre shades and mixtures of brown, blue and gray, relieved for ladies by the bright blues and embroidered decorations of the *obi*, and by glimpses of an under tunic of delicately tinted crépe at the neck, and even at the knees, as the wind roguishly thrusts the *kimono* aside.

Upon the feet short stockings, or foot mittens, are worn, fastened around the ankle by a simple clasp. They are cleft between the great and second toe, for the thong of their straw sandals or wooden clogs, which are always slipped off the feet and left at the door of the porch on entering a house.

During the past fifteen years European clothing has been adopted to a large extent in cities open to foreign influence, while the court costume and the official dress in all the departments of the government are of foreign style. Gowns and skirts are poorly adapted to the active pursuits of men, although they are still worn by all in their home life, and even by some foreigners during the relaxation from active duty which warm summer evenings invite.

One of the most striking adaptations of foreign costume which I saw — it was on a winter's day — consisted of the loin-cloth, which is never omitted, a heavy woollen overcoat, devoid of buttons, and a pair of wooden clogs, while from a staff over the shoulder was suspended a pair of foreign boots and trousers, which the noon-day sun had rendered quite superfluous.

While the Japanese wear no linen, or its equivalent, they are excessively given to hot bathing. It is customary to bathe daily. Some have bath-tubs at their houses, and they are always found in hotels; but the great mass of the people living in cities and towns resort to public bath-houses, where, for a fraction of a cent each, men, women and children may enjoy a social bath in large tanks, which are often exposed to view from the street. Bathing suits are quite superfluous. These houses are full of people every evening, and are more or less frequented during the day. Whether in dwelling, hotel or public bath-house, the tub is filled but once a day. Meanwhile, it may be patronized by hundreds. The purity of the water is preserved in some measure, however, by the disuse of soap, that article until recently being known in Japan only as an importation.*

During my travels, my antipathy to the cosmopolitan bath of the hotels was soon marked. I was therefore offered the first chance at the tub after the old water had been retired

* Its Japanese name, *shabon*, is taken from the Spanish *Xabon*, by whom it was introduced three hundred years ago.

from its long and arduous service, and a fresh supply brought into use. This privilege was for a time invariably declined. At length, after a week's absence from home comforts, and fearing that the reputation of foreigners for cleanliness was in danger, I ventured to accept the favor, charging my servant to see that the bath was suitably prepared. He soon announced it ready, led the way through a long hall to the kitchen, or open area of the hotel, and pointed to a small recess, in which was the bath-tub. It was a short rectangular trough of wood, projecting up through the bottom of which, near one end, was the usual iron cylinder, or furnace, full of burning charcoal. In the midst of the kitchen, in full view of the bath, sat the women and servants of the house, and several transient wayfarers. I looked nervously for slides with with to screen the bath, but was told that none were used. Less bold than Cassius, "upon the word, accoutered as I was, I plunged" *not* in, but quietly withdrew, and bade my servant follow, compromising the matter with a cold douche in a room adjoining my apartments.

Riding along the highways of the country, one not infrequently sees the members of a family bathing in a tub set by the roadside, or near the house, in any position convenient for fuel and water.

It is proper to add that, in deference to foreign sentiment and the native fruit thereof, the promiscuous bathing of the sexes is now disappearing.

If the use of soap is in truth an indication of a people's civilization, these were not far advanced. Even for shaving, which they practiced upon the scalp, eyebrows and ears, as well as upon the chin, the saliva of the barber was often used as the softening unguent.

It is evident, therefore, that the virtue of excessive cleanliness which writers have attributed to the Japanese, is not altogether deserved. Bathing is practiced rather as a sensuous luxury than for personal cleanliness. Their bedding, which consists of thick, matted quilts, is never washed, though sometimes aired. The drainage of their towns often flows into narrow channels, either open or covered with boards, which run along the sides of the street directly in front of the houses. If I were unconsciously transported to

a Japanese town, I should on awakening know my whereabouts by its unmistakable odors, many of which are the legitimate product of the kitchen.

The houses of the people are of the plainest character. They are usually of one story only, hotels, and some city houses which serve the double purpose of shop and dwelling, excepted. The woodwork is fastened by wooden pins and wedges. Paint is seldom used, palaces and cottages alike being of gray wood. Color and gilding is found only in temples, which indeed exhibit wonderful elaborations also in framing, wood carving and metal ornamentation. The panelled ceiling of one of the most beautiful temples which I visited was composed entirely of carved and polished tortoise shell.

Two or more sides of the house are open, from which one looks out over a narrow veranda, floored with polished pine or cedar, into a small inclosure of ground planted with chrysanthemums and a plum or cherry tree, and exhibiting with more or less elaboration a bit of their peculiar landscape gardening.

The interior partitions extend from the ceiling to within about six feet from the floor, the opening below being closed by means of light sliding screens of delicately framed lattice work covered with paper, by which the rooms are separated, and by removing which two or more rooms may be thrown together. The verandas are inclosed at night by similar screens or shutters of thin wood.

The walls of the house are usually of wood, sometimes of mud-plaster spread upon a web or lattice of bamboo strips woven together between the frame timbers, and are occasionally covered with lozenge-shaped tile. Roofs are covered with beautiful black tiling or thin shingles, held on by strips of board and weighted with stones (as in many Swiss cottages), or with a well-made thatch of rice straw, according to locality, and the means of the owner.

The rooms are carpeted with well-made mats of straw, bound with black cloth. They are from two to three inches thick, and of the uniform size of three by six Japanese feet.*

* It is interesting to note that the Japanese foot differs from the English by less than one-sixteenth of an inch.

These dimensions were fixed by a law of the empire, which also prescribed that the dimensions of rooms should be in multiples of three feet, in order that the mats might be readily interchanged or renewed.

Warmth is derived from charcoal burned in an open *hibachi*, consisting of a square box set in the floor and filled with sand, or in movable braziers.

Furniture is reduced to the lowest terms. They sit on their heels, and hence require no chairs. Their bedding is brought from an adjoining closet into the living room, and made up upon its mattress-like matting; hence no chamber furniture, unless we except the pillow, which is of wood and about the size and shape of a brick. It rests upon one of its longer edges, and upon its upper side is fastened a small round sack filled with rice-chaff. Upon this intractable affair the back of the sleeper's neck rests, while the head projects into space beyond. Thus the elaborate head-dress remains undisturbed, and the services of the hairdresser are ordinarily required but once or twice a week.

Their meals are set forth in little hand-dishes arranged on trays, one for each person; hence no dining-tables are required. Their food is cooked by boiling, broiling, or frying over the open *hibachi* of the kitchen; therefore no stoves are needed. A small writing-table, about a foot high, a sword-rack and a household shrine were the most common articles of furniture in houses whose occupants had occasion to use or possess them.

In nearly every room of a Japanese house you find the *tokonoma*. This is a shallow recess extending half-way across one end of the room, the other half being made into a closet or a cabinet of shells, exhibiting tasteful and decorative joinery. The floor of this recess is raised four or five inches, and here the dignity of the room is centered. It is the dais of the apartment. A few *kakemono* or hanging pictures, and the family legends painted or inscribed upon silk or paper, adorn it; while poetic inscriptions are likewise displayed, or written upon dainty strips of cedar and hung upon posts of the room. Similar decorations and paintings upon the sliding doors, and occasionally a folding screen, complete the adornments of their houses.

The beautiful and dainty works of art in bronze, lacquer, porcelain, carving, painting and embroidery, which we associate with Japanese art industry, do not appear in the homes of the people. They must be sought out in the houses of the wealthy, where they have been preserved as heirlooms, sometimes for many generations; in temples, under the patronage of which the arts, and especially painting, were fostered and their products preserved; or in small shops, to which have come many choice articles of *vertu* from the palaces of noblemen, whose estates have suffered the reverses of fortune incident to the political revolution of 1868.

To a people of our culinary tastes, the horrors of the Japanese kitchen are almost inconceivable until experienced. Many of the native dishes can be swallowed and digested by very few foreigners, and only after long and persevering practice, which few undertake, save from curiosity or necessity.

The social relations in Japan are matters of frequent inquiry. I am often asked, "What is the social status of Japanese women?" In their mythological account of the creation it is related that, while the god and goddess, *Izanagi* and *Izanami* (the parents of the sun goddess first mentioned), were sitting on the floating arch of the heavens, the god plunged his jewelled spear down into the depths of the sea. Withdrawing it, drops of water fell from the diamond point, which, condensing in their fall, formed the nucleus of the island empire. The pair at once descended to view this sample of their work, one going to the left and the other to the right, to make the circuit of the island. As they met again, the goddess in joyous rapture exclaimed, "How happy I am to see you again, my beloved spouse." But he, displeased because she had anticipated him, said: "Me, your husband, the strong and powerful, should be the first to speak; why do you, a female, speak first?" Her bad taste was deemed of ill-omen, and they renewed the circuit. The next time, as soon as he perceived her, he first exclaimed, "How happy am I to meet you again, my dear and amiable spouse."

This legend of the creation of Japan by the gods typifies

also the position of woman there to-day. While the supremacy of man is recognized and enjoined, mutual assistance and devotion are beautifully portrayed in these myths. In Confucius' "Record of Rights," much revered in Japan, it is written, "The man stands in importance before the woman: it is the right of the strong over the weak." Six centuries later, Paul wrote, "Wives, submit yourselves unto your husbands, for the husband is the head of the wife." The Confucian proverb, "The hen that crows in the morning brings misfortune," suggests a rhyming adage familiar doubtless to most of us.

Social custom in Japan consigns woman chiefly to her own home. Men meet for considerations common to their sex the world over, and women visit each other for friendship, companionship and for gossip; yet formal gatherings of both sexes in what we term "society," is hardly known.

Japan is acknowledged by most travellers, even by those who deplore the condition of their women, to be a heaven of contentment, and the paradise of children. To my mind, it is difficult to conceive of a social state in which conditions so contradictory co-exist with a downtrodden womanhood, or with unhappy motherhood.

If, as among the peasant class, where poverty compels the labor of all, women labor in the fields, it is a lighter portion of the work that they do, which the men requite by assuming the heavier drudgery of the house. Here, as elsewhere, woman lives upon the plane which her ability, force of character and quality of mind entitle her to. Eight of the rulers of Japan have been women—one of them her most famous conqueror.

At two large stores in Sapporo women were the principal owners and the managers. In one the wife furnished the capital, directed from six to ten male clerks, including two sons-in-law, while her husband served as head bookkeeper.

Japanese literature presents many charming pictures of devotion between husband and wife, while the love and respect which children at all ages bear their parents is unsurpassed in any country. Although it is lawful for the Mikado to have a dozen deputy wives, or concubines, and for other

men such a less number as their means and position may allow, it is also commendable in the eyes of the rising generation that they have none.

The Japanese is, as a rule, the husband of one wife, who enters upon her duties at so early an age that, save in the happiness of her children, it is a positive evil. Becoming a wife ere she ceases to be a child, she is still of childish character. Her children are not effeminately reared, however. Their clothing is loose and airy. They wear no head covering, and their hair is shaved in conventional and grotesque forms, varying with age and station.

The Japanese *kimono* and *obi*, by their peculiar service in the rearing of their children, entitle the people to a position among the marsupials (a group of animals having a pouch for carrying its immature young, of which the kangaroo is a type.) They carry the young child in the pocket formed above the girdle between the bare back and the loose *kimono*. There he reigns for the day with his head and arms free, playing with his straw rattle, crowing, crying or sleeping, while his protector for the time being (be it mother, father, brother or sister) walks, rides, works, plays, eats and smokes unhampered by the precious burden. By an easy movement of the child's head and shoulders under the mother's arm, it partakes of the nourishment nature provides, without interrupting her various duties. The elder children carry their younger brothers and sisters in like manner. Indeed, so early is the infant made the carrier of the babe, that it is often difficult to tell which is the elder of the two.

The expressions used in polite conversation among the higher classes are much burdened with stilted forms and figures of speech, the speaker putting himself in the most obsequious relation to the one addressed. For example, instead of asking one's opinion by the simple question, "What do you think of this?" one may say, "Be so good, if you will, as to hang this upon your august eyebrow?" If, however, one should address his servant or an inferior in the same terms in which he converses with an equal, he would hardly be understood.

Extreme courtesy marks the intercourse of respectable people, although coarseness and banter may characterize

much idle tattling and gossip among the lower classes; and, while profanity is not indigenous, in periods of anger, contempt or derision, such emphatic epithets as, "ruffian," "villain," "fool," "beast," "scoundrel," etc., are not uncommon.

The ingrained courtesy of speech common to these people leads them often to put a more favorable construction upon some of the inelegant expressions too common among a certain type of foreigners than they deserve, or than greater familiarity with the vernacular of foreign sailors and adventurers would justify. An amusing instance is related by Miss Bird. On one occasion she remarked to her interpreter, "What a beautiful day is this." Immediately consulting his note book, "You say 'beautiful day.' Is that better English than 'devilish fine day,' which most foreigners say?" Surely foreign teachers and missionaries are not to be credited with all the evidences of civilization in Japan.

One of the most worthy of the foreign employees of the government, a gentleman of French birth but of American citizenship, was the general engineer and superintendent of the mines in Yezo. I knew him as a man of the strictest honor and integrity, and having a keen sense of justice; such a one as the Japanese themselves would term a square man. Becoming the victim of unfulfilled promises on the part of certain officials, concerning the management of mines delegated to him under his contract, he had tendered his resignation (much against their wish), to take effect in three months, and was called to Tokio to await the expiration of this period.

In the meantime, while annoyed by the persistent efforts of the higher officials to bend him to their purposes by the offer of pecuniary advancement, in substitution for the executive authority of which they had deprived him, a telegram came from the mines saying that they were on fire, and asking what should be done. The officials, seeking safety in the time of danger, dispatched a messenger to my friend's house. The engineer, on hearing the hurried message, ejaculated with undue emphasis of impatience, "Oh, damn it!" turned on his heel, and, ere he could collect himself,

the interpreter had departed post-haste. The officials immediately telegraphed his concise instructions to the mine. The workmen forthwith stopped the mouth of the tunnel leading into the coal-veins, and a mountain stream close at hand was turned into the shaft above. The mine was flooded, the fire extinguished, leaving the officials more exasperated than ever, that with neither their blandishments nor their gold could they prevail upon so capable a man to overlook their caprice and continue in their service.

Not only geographically are the Japanese our antipodes, but philosophically they may be looked upon as our opposites. In the making of books, newspapers and manuscripts, the title is placed upon what we would call the back cover, and reads, like the text within, from top to bottom, instead of across the page, the lines running vertically, instead of horizontally. The matter begins on the right hand side, and reads towards the left. They call our penmanship crab writing, because it goes backward like a crawfish

In their old system of school-teaching the children studied and were taught at school, but recited at home, whereby the parents might know if the master did his duty. The pupils also studied aloud, each one shouting the names of the Chinese characters or Japanese *kana* in stentorian tones, whereby the teacher knew which ones were attending to business.

Japanese carpenters draw the plane, and pull the saw on the cutting stroke. The floor or ground is their work-bench, and their toes serve for prehensile purposes.

Hewers of wood stand upon the side of the timber opposite that to be hewn.

The blacksmith puts his forge and anvil on the ground, and to deliver heavy blows stands in a hole so as to bring his work at proper height. At light work he sits on the floor.

The Japanese farmer beats a rack with a bundle of grain, instead of beating the grain with a flail. A flail is used for threshing the broken heads of grain, however, but it is swung outside instead of inside the handle. In their hay-cutters the hay is pressed against the knife, instead of the knife against the hay.

In rolling up paper, wall-hangings, etc., they invariably

turn the top of the roll toward the body, with the palms of the hands upwards; we turn it from the body, with the palms of the hands downward.

There the candle is impaled upon the stick, the stick being inserted in a hole in the candle, while we insert the candle in a hole in the stick. There candles also are large at the top and taper toward the bottom.

Japanese oars are pivoted upon a pin, and not between pins; the row-lock is inserted in the oar, while we insert the oar in the row-lock.

I have seen a stone-cutter returning from work on a hot summer's evening carrying all his various heavy tools upon a tray, suspended from one end of a balance pole over his shoulder, with a counterpoise of stones hung from the other end. Pack-saddles were sometimes balanced in like manner.

Housemaids dust first and sweep afterwards.

The short cue of our wigged colonial ancestor hung downward behind, while that of the Japanese projects upward toward the front.

A student was given, as a topic for a written examination, "The economy of brains in agriculture." His dissertation thereon being brief, I give it in full; "Brains are the most precious and refined part of the human body. We should therefore be very economical in their use," a kind of philosophy too much in vogue the world over.

In ceremonial affairs, the left outranks the right.

Etiquette is better than morality, and equal to a liberal education.

Courtship follows, not precedes marriage.

Under the native marriage customs, not only is a prior courtship unknown, but the preferences of the contracting parties were not consulted, and they may never have spoken before the ceremony.

It is not always a good rule that works both ways; a wife cannot sue for divorce upon the same grounds for which she may be put away.

The Japanese superstitiously avoid sleeping with the head to the north, that being the position in which the dead are buried. I have often seen diagrams of the cardinal points of the compass drawn or pasted upon the ceiling of rooms

in native hotels for the benefit of the superstitious guest, while travellers often carry a magnetic compass for the same purpose.

The order in which they enumerate the points of the compass is the reverse of ours, — *To, sai, nam, boku;* or, east, west, south, north.

Equestrians mount and dismount on the right side of the horse, and the rule of the road is that they shall turn to the left.

A decorous manner and a proper show of respect to your host are manifested by a loud supping noise when you drink tea and take food, and likewise by sucking air between the lips and teeth as you make your salaam on meeting a person of equal or superior rank.

It is the impulse of a Caucasian, under cruder systems of government, to kill the enemy who insults or grossly injures him; the Japanese who is wronged kills himself to spite his foe.

Examples of contrariety might be multiplied to an almost endless extent. Even the golden rule of Confucius is negative, — "What you *do not want* done to yourself, *do not do* to others" One might easily conceive the Occident and the Orient to be at the opposite poles of some mysterious magnetic or psychological influence, actuating their respective systems of civilization.

The religious character of the Japanese as a people appears to be in a transition state. The law of the empire punishing with death the teaching of Christianity became long ago practically inoperative; and Christian missionary enterprise is now tolerated, not so much perhaps because the government is favorably inclined toward it, as because of the apparent decay of their own religious ideas and dogmas.

Many of the Buddhist sermons are of high moral excellence, and indeed most interesting. In its forms of worship Buddhism is strikingly similar to Romanism. While witnessing the ceremonial ministrations of the priests, in one of their ornate temples, aided usually by a lay clerk, both in long gowns before an altar on which candles are kept constantly burning; while listening to their monotonous intonations and the responses of the kneeling congregations, and

to the discourse of the priest with which the exercises generally closed, I would almost believe myself in a Roman Catholic church.

The ceremonials of the so-called native religion, *Shinto,* which signifies "the way of the gods," and which Buddhism found there on its introduction in the sixth century, still have much in common with that which Buddha himself is said to have found in India nearly twelve centuries earlier.

Edwin Arnold, in his "Light of Asia," gives us this picture: —

> "For, on a dawn, he walked there and beheld
> The householder Singala, newly bathed,
> Bowing himself with bare head to the earth,
> To heaven, and all four quarters, while he threw
> Rice, red and white, from both hands. 'Wherefore thus
> Bowest thou, brother?' said the lord; and he, —
> 'It is the way, great sir! Our fathers taught,
> At every dawn, before the toil begins,
> To hold off evil from the sky above
> And earth beneath, and all the winds which blow.'"

The same ceremony of throwing "rice, red and white, from both hands," bowing "with bare head to the earth, to heaven and all four quarters," I have often witnessed at the Shinto temples of the government on the celebration of the festival *Niiname*, the Japanese thanksgiving day, as well as on other occasions, concerning which the same explanation was given me by a native priest who took part therein; that is to say, to propitiate the evil spirits, or to "hold off evil" in the *Rikugo*, the six sides of the universe.

A Japanese acquaintance of mine, who, as interpreter, accompanied the great embassy from Japan to America in 1872, was asked the difference between *Buddhism* and *Shinto*. He said, "We imported *Buddhism*, but *Shinto* we created." In truth, *Shinto* is the mythological religious inheritance which the Japanese brought to their island domain in prehistoric times, while Buddhism followed them there later on, as it overspread half the inhabited world.

In connection with the scattering of rice and the offering of food before the altar and mirror in their temples, the ceremony of sweeping out the evil spirits from the six sides of the universe is first performed. For this purpose, the de-

partment of the state religion at Tokio provides each government temple annually with an instrument consisting of a stick resembling a broom handle, to one end of which a quantity of tough white paper cut into strips after a peculiar conventional fashion is fastened. With this the chief priest walks formally into the centre of a large area before the temple, around which the people are assembled. There he faces in proper order the several sides of the universe, and by vigorous passes of this wand he sweeps out the evil influences; then follows the scattering of rice, after which offerings are made before the altar and the mirror, such of these as the gods may leave for that purpose becoming a rich perquisite of the priestly office.

Upon the 14th of February, in 1879, a letter in Japanese was brought to my classroom by a messenger from the local capitol. I passed it to an intelligent student for verbal translation. Our students, like the official classes, generally were not ardent devotees of their religion, a large number of them indeed having professed the orthodox Christian faith under the guidance of the late President Clark. His sombre visage brightened, and his eye twinkled, as he interpreted the following official notification: "Sir, to-morrow will be a holiday, for God is come from Tokio." The glad tidings were duly appreciated by the listeners, all of whom recognized the propriety of the observance of an event so important in the annals of Sapporo. The god that came from Tokio was the spirit exterminator or broom, of which I have spoken, the day after it is received being set apart each year for its dedication and use.

There are no better standards for gauging the physical well-being of a people than the agricultural development of their territory, their annual production of wealth, and the amount and character of the food they consume.

A few comparisons between the sea-girt empire of Japan and the insular kingdom of Great Britain and Ireland reveal some illustrative facts.

The area of Japan is 143,000, and of the British Isles 122,000 square miles. Their populations in 1874 were 33,300,00 and 32,600,000, respectively, being at the rates of 234 and 267 per square mile.

Now, while only twelve per cent of Japan's territory is cultivated, not less than fifty-six per cent of the soil of Great Britain and Ireland is agriculturally improved. In other words, England cultivates more than *four*-thirds, and Japan less than *one*-third of an acre per capita. Nevertheless, Japan produces all she eats and drinks, all that she wears, the tobacco which she smokes, sends rice and fish to China in case of famine there, and raises a large surplus of raw silk and tea for exportation to America and Europe.

The United Kingdom, on the other hand, tilling four times as much land per inhabitant, would starve but for foreign granaries and pastures, and would return to comparative nakedness but for the cotton-fields and mulberry plantations of other climes. She is obliged to import more than one-half of the food and drink she consumes, all the cotton and silk she wears, and the tobacco that she smokes.

This striking disparity, though due in some measure to the great productiveness of the fisheries of Japan, is chiefly owing to the wide difference in their systems of farming and food supply.

Agriculturally speaking, the Japanese is a vegetarian, while the Briton is a beef and mutton consumer.

The same area of land that will furnish food of a mixed diet like that of the English and American people, for one man, will feed six or more upon a granivorous and vegetable diet. The English system of farming and of food production involves the maintenance of over fifty million domestic animals, *exclusive* of horses, — that is to say, cows, sheep and swine, — while Japan supports less than three million; and the maintenance of these domestic animals alone of Great Britain, under her system of high farming, requires the product of more than three times the whole area cultivated in Japan.

Naturally, therefore, the cost of the Englishman's diet is far greater than that of the Japanese, the average values of their crude food materials being about sixty dollars and ten dollars per annum, respectively.

Plain boiled rice, eaten without sugar, salt or condiment, constitutes sixty per cent of everything that goes into the stomach of Japan; while less than one-half of one per cent of England's diet is of this grain.

On the other hand, twenty-one per cent in value of the food supply of England is of the flesh of domestic animals, poultry and game, of which articles Japan consumes less than one-half of one per cent.

Alcoholic drinks constitute eight per cent of the total value of the food consumption of Great Britain, — one of the greatest consumers of intoxicating beverages among civilized countries, — and twelve per cent of that of Japan.

Regarding the subject of alcoholic intemperance in Japan, it ought to be said that drinking is chiefly indulged in within their own houses, where during intoxication they usually remain; hence it is that disturbances of the peace and the ordinary signs of intemperance are comparatively rare.

To the higher nutritive value of the nitrogenous and phosphatic foods of Western nations is closely allied, not only its higher commercial value, but also the greater energy and efficiency of the races of men raised thereon, — of the brain and brawn so nourished.

Said General Kuroda, then colonial secretary, now prime minister, "You must not expect too much of the Japanese; it takes six of them to do as much as one foreigner."

In the construction of public works I found that the labor of Japanese coolies, at twenty-five cents each, was no cheaper than that of Americans at a dollar and a half per day. Improved tools and machinery did not account for the difference. The construction of extensive earthworks was more cheaply performed by carrying the material in sacks slung upon poles, than by wheeling it in barrows or carts. For several years, General Capron said, it cost as much at government mills to saw lumber by steam and water-power, using the best American machinery, as by the hand labor of natives.

The annual income or production of wealth in Japan in 1874 was only $12.50 per capita, of which they ate nearly eighty per cent in value; while in England and America it was nearly twelve times as much, of which the people ate only forty per cent in value.

The annual increase of wealth in Japan is therefore exceedingly small. * Clothing and taxes exhaust most of

* The government levies a tax of two and one-half per cent upon the full value of the land for general purposes, and one-half of one per cent in addition for local purposes.

the remainder of the annual production, although their shoes cost less than six cents per annum for each person.

The average annual salary of the postmasters in 1876, about four thousand in number, was $17.66; in 1877, $22.20. Certainly not a serious provocation for turning the rascals out, should a change of administration occur. The mean compensation of American postmasters last year (over fifty-five thousand in number) was $216.50.

The Japanese farmer tills seven-tenths of an acre, while the American farmer cultivates seven acres, or just ten times as much, for each one of the agricultural population. The average value of the crops per acre in both cases is the same, being about twenty-two dollars.

A dwelling worth two hundred dollars is a rarer and finer mansion there than one costing two thousand dollars in America, while fewer families expend fifty dollars for furnishing in Japan than there are that devote ten times as much to the same purposes here.

The ratio of one to ten seems to represent approximately therefore the relative efficiency of the two races, with their attendant systems of civilization and government.

No event is more significant of the completeness of the social and political transformation of Japan in our day, than the disestablishment of feudalism, and the peaceful disarmament of the *Samurai*, the privileged two-sworded or military class, comprising over a million men, in whose feudal chiefs, the *daimios*, the civil as well as military authority of the empire was practically vested. A step towards this end was effected in the overthrow of the Shogun in 1868; and in March, 1876, just three months before my arrival at Tokio, the wearing of swords by this class was terminated by the mandate of the Mikado.

The Samurai or two-sworded class constitute an inferior order of nobility, outranking, in the sequence named, farmers, artisans, merchants, coolies, and, at the foot of the scale, the socially despised tanners, butchers and executioners; and the feudal code armed each member of that class with authority to cut down, on the most trivial provocation, any of the thirty million plebeians of the empire.

Concerning their duty in dealing with oppressors of equal

or higher rank, the same code prescribed that, "in respect to revenging injury done to master or father, it is granted by the wise and virtuous (that is, Confucius) that you and the injurer cannot live together under the canopy of heaven."

Such was the legal foundation of the vendetta in Japan; yet this right of private redress was exercised upon a higher basis and under wiser restrictions than was the vendetta or blood-feud among the early Greeks, the European tribes of the middle ages, the modern Bedouins and Corsicans, or the relic of similar barbarism still existing in some of our own south-western States; for the public peace was not to be endangered, nor were riotous proceedings to attend its execution.

But they who live by the sword perchance must die by the sword, and in no feature were the rules of the code more formal or complete than in that wonderful ceremony of self-dispatch, vulgarly called *hara-kiri*, or "belly-cut," but more properly termed *seppuku*.

The short sword of the Samurai, guided by his own hand, secured to him lasting honor, whatever the turn of fickle fortune that compelled him to end his life. It rescued his name from the iniquity of defeat, was a fit antidote for blasted hopes and ambitions, and even secured to him honorable death under condemnation of his prince to capital punishment. To the weapon upon which he relied for renown in life, he turned for a meed of grim glory in death.

The honorable penalty of self-disembowelment in capital execution latterly gave way to the custom of striking off the head while the victim went through the preliminary ceremonies of self-dispatch, such as reaching forward to receive his short sword from a second or assistant in front of him.

The person appointed to inflict the death-blow in such cases was considered to act in the capacity of, and even was, a dear friend or faithful servant of the prisoner, using for this purpose his own sword, or that of the victim.

Christ said, "Greater love hath no man than this, that a man lay down his life for his friend." But where, save in the land of that human paradox, the Japanese, were youth ever taught that the last tribute of affection which one may have to pay his best friend may be to act as his executioner?

Indeed, it is hard to conceive that these meek and courteous people of to-day were actors in the many sublime tragedies which color their history, inspire their drama, invigorate their literature, and point countless tales current among their professional story-tellers.

A former secretary of the British legation recounts the case of a young Samurai, twenty years old, who, not content with inflicting the one conventional cut across the abdomen, with an upward twist of the blade at the finish, with fierce determination slashed himself thrice across and twice vertically, then, with unfailing resolution, plunged the blade full through his neck in front of the spinal column, with its keen edge to the front, and, setting his teeth, in one supreme effort with both hands drove the weapon forward, and fell dead, an object of admiration.

The debasing influence of our luxurious civilization upon this heroic custom is perhaps shown in an event marking the close of the public career of the last Taikun or Shogun in 1868. Defeated on every side, he fled to Yedo, ignominiously resolved to yield everything and fight no more.

A faithful councillor thereupon said to him: "My lord, it only remains for you now to retrieve the honor of the family of Tokugawa by committing *seppuku*; and, that you may be assured of my sincerity and allegiance, I come to disembowel myself with you." The Taikun, however, evidently realized that the day had dawned in Japan in which one might choose rather to live an enlightened coward than to die a deluded hero, for he declared he would have no such nonsense, and left the room, while his faithful retainer retired to another part of the castle and solemnly performed the *hara-kiri*.

I was told by one of his former followers, who ten years before might himself have cut down a tradesman for refusing to bend the knee and bump the ignoble head on the ground, that the ex-Taikun had become a merchant.

It was with peculiar interest that I called upon him (now the Marquis Tokugawa) at Boston last winter, and heard him express his views upon the cause of liberal Christianity in Japan, in which he has become interested.

Since the downfall of the Taikun and the restoration of the

Mikado in 1868, the government has been in reality an oligarchy, a simple despotism in form, administered by a supreme council, consisting of the prime minister, the left and right vice-prime ministers, and ten ministerial heads of the various departments. Their task is far from being an easy one. They have been obliged to defer more or less to the needs and prejudices of a large army of beaurocrats, in whose ranks many of the Samurai have found refuge.

Constitutional means have been devised, to take effect next year, for the establishment of a representative assembly or legislature clothed with limited powers at the outset, but which will serve the effective purpose of securing an expression of the more intelligent public sentiment existing throughout the empire.

None of the members of the imperial cabinet, with possibly one exception, were nobles of high rank, but simply respectable Samurai, some of whom, up to the time of the restoration, or even later, were bitter opponents of foreign innovations.

The career of the present prime minister, General Kuroda, under whose administration as colonial minister I served, affords an apt illustration.

I well remember the keen zest with which he related the principal events of his early life, one beautiful summer's day in 1876, as we steamed up the eastern coast of Japan on our first journey to Yezo, in a fine vessel bearing his name.

Kuroda belonged to the powerful clan of Satsuma. He inherited the national hatred of foreigners, and in 1862, at twenty-two years of age, was one of the party who cut down Richardson, an Englishman, for presuming to pass through the imposing retinue of his prince, while proceeding along the Tokaido near Yokohama.

Witnessing the power of the English guns in the bombardment of the Satsuma capital, by which mighty England rebuked proud Satsuma for this high-handed offence, his hatred of foreigners was intensified; but his eyes were opened to the fact, that, to cope with and drive out the intruders, they must learn from them their art of warfare.

Accordingly, although it was then a capital offence for a Japanese to leave his country without the permission of the

Taikun's government, Kuroda was secretly ordered by Prince Satsuma to make a tour abroad for the study of military and naval affairs.

But the first indications of the struggle between the adherents of the Mikado and Taikun now appeared. The Satsuma clan upheld the Mikado's cause, and Kuroda was appointed a general in the imperial army. He had pointed out to us a few days before, in Tokio, the ground where the last battle was fought on the mainland, and the Taikun's power broken.

The following year, he, as commander of the army of the north, compelled the surrender of the remnant of the Taikun's army at Hakodate.

Their leader, Admiral Enomoto, together with his principal officers, were, as a matter of course, condemned to death by the central authorities. Kuroda, however, protested affirming that they had fought bravely and faithfully for their chief; that they would prove equally valiant and patriotic in their renewed allegiance to the Mikado; and, rather than consent that the honor of brave soldiers should thus be sullied, his own head should pay the forfeit. His will prevailed, and their lives were spared.

Enomoto subsequently became Kuroda's colleague as assistant secretary of the colonial department, and two years later was appointed vice-admiral and minister to Russia.

Three years afterward he returned overland through Siberia to Sapporo, where I met him as the guest of Kuroda. At a state dinner then given him, Enomoto paid a glowing tribute to the resolute will and courage of his present host, who had ventured his own life, with all its bright promise, to save that of his vanquished foe, the speaker.

No name in Japan has figured more conspicuously in the crisis of the restoration, been held in greater admiration, or clothed with more tragic interest, than that of Saigo. Two brothers of the name have attained to places in the imperial cabinet, after receiving the highest military honors the nation could bestow. The younger I met in Philadelphia, where he served as commissioner at our centennial exhibition.

The Saigos also were retainers of Satsuma. Both were adherents of the emperor's cause against the Taikun; and,

when the struggle became open and bitter, as it did largely through the elder Saigo's courageous championship of the emperor's cause, after fifteen years of marvellous adventure and hardship, he naturally became the leader of the imperial forces; and it was due to the wonderful success of his leadership that the war of the restoration was so brief.

At its close the Mikado decreed him a liberal pension, and in 1871 he was appointed to the imperial cabinet. Two years later he was made general-in-chief of the army; his old opponent, the ex-commander of the Shogun's forces, entering the cabinet in the same year.

Disagreement in the cabinet soon led to Saigo's withdrawal, after which, despite the overtures of the government, and even the commands of the emperer ordering the return of the man most influential in his restoration, he lived in Satsuma in comparative retirement, devoting his time to the direction of what were avowedly private schools, but which the Satsuma rebellion of 1877 disclosed to be military academies, containing several thousand students under foreign instructors, and supported in part by the pension which the Mikado had bestowed upon him. In the last throes of this rebellion, of which he became the leader, while general of the imperial army, he lost his life; by whose hand it is uncertain.

At the outbreak of the Satsuma rebellion the younger Saigo was also a general in the imperial army, and the universal query was, "What will he do?" He was immediately appointed acting minister of war, and, vibrating between the seat of government and the scene of the rebellion, where, with Kuroda, they directed the campaign against their late chief, his brother, he put forth every effort for his country. Six months saw the end of the conflict, when he was spared the pain of justifying his elder brother's beheadal by that brother's mysterious death. The living Saigo soon after became, and still continues, minister of war.

A story of the wonderful prowess and strategic skill and diplomacy which marked his debut on the political stage was told me. Prior to the restoration, while going to Satsuma with others of his clan to attend a meeting of the Imperialists at Kioto, they fell in with another party whose leaders were

sympathizers of the Taikun. A controversy ensued, however, as to which side should be taken in the impending struggle. It was decided to hold a council that night in a room secured for the purpose. Accordingly, while their followers encamped without, Saigo and three of his companions on the one side, and six or eight of the other clan, met at the appointed time and place. The discussion continued far into the night, Saigo's party having from the first, however, no thought of yielding, while the adverse majority proved equally determined.

Suddenly, at a pre-arranged signal, the paper lanterns were extinguished, and, without a word, Saigo and his three associates sprang each to a separate corner of the room, where, drawing their short swords, they covered the sliding doors, preventing any escape, and to the right, left and front, cut and thrust until no living thing remained to receive their blows. The opponents were slain, and their clansmen, being without leaders, consented to abide by the decision of council, and forthwith joined the Imperialists.

A striking coincidence appears in the lives of the two brothers Mori. Mori Arinori, the younger, formerly minister to China, now vice-minister of education, was one of the first Japanese educated abroad, and was likewise first to receive a foreign diplomatic appointment, having been appointed acting minister to the United States in 1871. While here he interested himself in the problem of education for Japan, reaching the radical conclusion, that only by the adoption of the Roman alphabet and the English language could she attain high rank in science, literature and government, her own tongue being incapable of extreme accuracy of expression.

Minister Mori was the first to advocate the abolition of the sword, and it was largely due to his efforts that the notification of the 28th of March, 1876, to that end, was promulgated.

He has indeed personal as well as political incentives in promoting this measure. While he was learning the better ways of our civilization, his brother, Mori Yokoyama, a civil officer of high rank, urged upon the government certain state policies, but without success; whereupon he declared, that,

having devoted the full measure of his strength and influence to advance his country's interest, without avail, he would seal his patriotism with death, and so died by his own sword.

Three months after the abolition of the sword it was my privilege to dine with Minister Mori and others, at his resi-in Yedo. It was a beautiful Sunday afternoon. There were present: Kuroda, Samishami, minister to France (whose face was of a pure Grecian type), Okubo, minister of the home department, afterwards vice-prime minister, and others. Okubo was perhaps the most influential man in Japan, certainly more thoroughly identified with its modern exotic development, and more exposed to the hatred and calumny of obstructionists than any other. In less than two years he was waylaid and assassinated by four Samurai, armed with the proscribed sword, while on his way to the imperial council chamber. His assassins immediately delivered themselves up to the authorities, — voluntary sacrifices, as they asserted, in behalf of their oppressed fellow-men.

Not the least interesting of those present was Lady Mori, tiny and slight of figure, in dainty European costume. She appeared only at the table, however, where she occupied one of the humbler places. She was addressed twice or thrice, and then only by such of the company as chanced by their inferior rank to sit near her. It was, however, a concession to foreign etiquette that she appeared at all.

While speaking of the men most conspicuous in the oligarchy which surrounds the throne of Japan, a word is due the emperor who sits upon it. He is the first Mikado during many generations who has made even a pretence of having a voice in the government. On his accession to the throne in 1868, at the age of fifteen, he ignored the precedents of centuries, burst the doors of his sacred prison, appeared before his people, and pledged to them the future attainment of a constitutional government. It is difficult to say how far this manifestation sprung from his own mind, or what is his real part in the government. Doubtless we may say of him, as was once said of the king of the French, "The king reigns, but he does not govern."

While the features of the emperor are not indicative of a high order of ability, yet he is generally believed by foreigners to be a man of liberal views, and is deservedly popular.

Feb. 11, 1879, I witnessed the Shinto festival, commemorating the 2,539th anniversary of the accession of the first emperor, Jimmu Tenno, and on the third day of November following I attended the celebration of the twenty-seventh birthday of his royal descendant of the 121st generation, the present emperor.

The great length of the imperial line is largely due to its crookedness. Any child of the emperor may become heir to the throne, whether by the empress or one of his majesty's concubines; and, since that branch of his family is limited only to twelve, it is no fault of the system if the line becomes extinct. The heir apparent is such a son.

However much the views of foreigners concerning Japan's people may differ, I doubt if ever a traveller spoke or wrote of her scenery save in terms of unqualified admiration. I hesitate to attempt a just tribute to its enchanting variety, warmth and beauty. Japan is indeed the traveller's paradise. It is a bit of creation more than worthy the authorship of her traditional gods, or to be the abode of their children.

Imagine yourself wafted away to the shores of the bay of Yedo, to a landscape most fair and smiling. Gentle slopes, crested by dark fringes of gnarled pines and stately firs, and clothed in dense masses of feathery bamboo, lead down to the sea. The quaint eaves of many a sombre-lined temple and holy shrine peep out here and there from the groves The bay itself is studded with picturesque fisher-craft, the torches of which nightly shine like glow-worms among the outlying forts, and against the dusky shore as far as the eye can reach. Far away to the west, beyond the twin hills of Hakone pass, Fijiyama, the "peerless mountain," rises above the plain, from which tradition gave it birth in fiery flames one night two-and-twenty centuries ago. It reaches its hoary head far above the summer clouds, as if to gaze upon the fair face of its twin-born sister, the beautiful Lake Biwa, three hundred miles beyond, which the self-same night was cradled there as Fuji arose to view. Milton conceived a scene like this when he wrote: —

> "So high as heaved the tumid hill, so low
> Down sank the hollow bottom, broad and deep
> Capacious bed of waters."

For a glimpse of Japanese scenery fresh from nature's hand, nothing can surpass a journey through the Island of Yezo. There we spent weeks and months among her grand volcanic mountains, her luxuriant vine-draped forests, in her fertile valleys, and along her rugged, precipitous coasts, — traversing the best highways the empire could boast, and the most devious and nearly impassable trails and bridle-paths the mind can conceive. Not the least of the fascinations which draw me back to those familiar scenes comes from the zest which a strong flavor of adventure and danger inspired; while the wonders of nature's laboratory there displayed are perhaps unequalled in few places outside our own Yellowstone Park.

But not alone in Tokio, the treasuried capital, which natives love and travellers delight in, nor in its suburban scenes enriched by the landscape gardener's art, nor yet in the primeval grandeur of the unfrequented north, does the memory most revel in. The interior of old Japan presents a type of domestic scenery surrounding the humble peasantry, of quaint and simple beauty. Cosily and most comfortably seated in that dainty two-wheeled vehicle, the *jinrikisha*, or "man-power carriage," a sprite of human form and proportions whisks you along over narrow and devious paths, through a strange medley of man's and nature's patchwork, — of pines and palms, of rice fields and fragrant buckwheat, of elm and bamboo groves, of tea and cotton fields.

Through azalea thickets and camellia groves, across tobacco fields, and past rocks covered with ferns of a hundred kinds and crowned with grotesque remains, through forests of green and scarlet maple, and over mountains clad in rich verdure, you may journey in perfect peace, safe from robbers, safe from violence, safe even from beggars.

The maidens sweetly say *Ohayo*, "good-morning," as you pass, where a few years since you might have been sliced up by the sharp swords of the Samurai. *Ohayo*, too, call the laborers in the fields, and the pilgrims by the way-side, while a general *kombanwa*, "good evening," in musical voices and with eager courtesy, greets your arrival at eventide at an hospitable inn.

Bidding farewell to this island empire of the rising sun,

for full two score miles does the enchanting panorama of the placid bay of Yedo attend you, even through the bold-beaconed bluffs at its portal, the veritable "rock-gate of heaven." Here, as your ship bravely sets her prow toward America, you turn back for a last lingering look toward the vanishing scenes astern.

Through the long, the almost sad waning of the day, the rugged coast-line sinks, the sharp outlines of the mountain masses are dimmed by increasing distance, growing more and more shadowy, until at length only great solitary Fuji, the "matchless mountain," is distinguishable above the cloud-land in which all forms are lost.

It seems a mighty symbol of the nation's being, above whose mythical foundation and source — now shrouded in the mists and shadows of time and tradition — appear the outlines of a history towering up through the ages into the clear atmosphere of present knowledge. And, ere the symbol fades from view, a radiant halo of sunset splendor bursts up through the mists and clouds about it, gilding the sharply truncated summit, — the same sun that even then is quickening the earnest life of a higher civilization in the West, seeming to hold out to the people of this the hope and promise of a brighter and better moral, social and political life than had been conceived in that first great volume of their history, the close of which our day has witnessed.

Adjourned to Wednesday, at 9.30.

SECOND DAY.

The meeting was called to order at half-past nine o'clock, Mr. Grinnell in the chair.

The CHAIRMAN. The Executive Committee, gentlemen, have requested me to preside over the meeting to-day, I suppose as a matter of compliment to me as being the sole survivor of the first body of the Board of Agriculture established in this State, the last original member of the Board.

The inception and the object of the Board of Agriculture and its accomplishments were so ably set forth by our eloquent chairman, yesterday, that it needs nothing further from me. It is a pleasure for us to meet and continue our association year after year. It is a great pleasure to meet the farmers and the people of the vicinity in which we hold our meetings, and the benefits of these meetings are and have been great. There is one thing to which I wish to allude, and that is, the results of our meeting, our essays, and of our discussions. I regard as among the most valuable part of the proceedings the admirable reports of our Board which have been published for thirty-five years, and have been taken as models by many Boards of Agriculture in other States. Commenced as they were in a most admirable manner, and continued in the same way, they form a great addition to a farmer's library, and I know that many an evening hour is whiled away by the perusal of those volumes at many farmers' firesides. These reports grow in value every year; and, as valuable as they have been, it is certainly proper that I should say that they have lost nothing of their value and their interest, nor of the admirable manner in which they are arranged, under our present secretary, who has accomplished all that the best of his friends wished for him when they elected him two years ago. [Applause.]

Our yesterday's discussions were upon the means of fertilization and of raising crops; to-day the programme turns mostly upon the results of those means upon the crops

which we raise, and largely to those smaller crops so essential to our comfort and true pecuniary success as farmers. The first of those to-day will be read by a gentleman whom you all know, who is prominent in his own county and in the State, and who has besides had a large practical experience in growing cranberries in the interior of the State. I think it is desirable to have the experience of such a man, as most of our papers and most of the discussions on that subject have been confined to the great cranberry bogs along the coast. The essay on cranberry culture will be read by the Hon. J. W. Stockwell of Sutton, whom it is my pleasure to introduce to you.

CRANBERRY CULTURE.

BY J. W. STOCKWELL OF SUTTON.

The cranberry is supposed to have been so named, says White, "from the appearance of its bud." Just before expanding into the perfect flower, the stem, calyx and petals resemble the neck, head and bill of the crane; hence the name "craneberry" or cranberry. I have never noticed this resemblance, but had supposed it took its name from being found on the borders of ponds and in wet meadows or marshes, where the cranes or herons "most do congregate." Be this as it may, its bud and blossom are beautiful, and resemble, in their general appearance, the bud and blossom of the "patridge-berry," or of the green-house plant, the bouvardia, — not quite so large as the latter, and much larger than the former, but of similar form and of a delicate pink color.

The cranberry is a native of North America, and is found from Virginia to Minnesota. It is a vine, trailing along the ground, sometimes on rich soil, in favorable locations, running ten feet or more, sending out branches, and these branches other smaller ones, so that when broken near its root, and carefully drawn out, you have a long vine, interwoven with others, sufficient to cover a large plat of ground. These branches send down from the joints numerous little roots to help sustain the plant and to grow the fruit, but not in such numbers as would *seem* needful to support so much life and perfect the berry. And this peculiarity is explained by the

analysis of the fruit, which is found to contain less than two-tenths of one per cent of organic matter as derived from the soil, all the rest being derived from the air and from water; science thus showing us how little except air and water, in the laboratory of nature, are needed for productive growth. The leaves of the cranberry vine are oblong, and vary in hue from a bronze to a dark green. The fruit is of a light green color when growing, turning to a lighter green before taking on its rich crimson tint of ripeness. The color of the mature fruit varies, with soil, mode of culture, location and variety of berry, from the light red of our inland bogs to the "black-cap" of the Cape. The dark color has been thought to indicate thorough ripeness, — a mistake that has often had an undue influence in the market in favor of the poorer table berry, and discouraging to the planting of inland bogs, because the difference of one dollar or one dollar and fifty cents per barrel is often the difference between profit and loss. Were this dark berry really the better fruit, it would be well; but when, instead, the lighter is the finer flavored, the richer, the more juicy, and of brighter color when on the table, then it would seem that inland cultivated berries should be preferred by good housekeepers. The difference between the dark berry of the Cape and the lighter colored inland berry of the improved bog, I will illustrate by the comparison familiar to us farmers between the two varieties of apple — the Roxbury Russet and the Rhode Island Greening: the one drier, with a thicker skin, can be handled more roughly and is the better keeper; the other, with a thinner skin, more juicy and tender, is easily injured, and decays sooner if injured. I used a few days ago some of the lighter colored berries, picked more than a year since, which were as fresh and finely flavored as if just gathered from the vines. However, the *fact* remains, the purchaser seldom cares for the difference in flavor, or knows that there is any — a cranberry is a cranberry to him, and nothing more; so the dark colored fruit will hold its vantage, especially as dealers will always prefer it because it is the better keeper, and consequently there is less danger of decay and loss.

This difference is largely due to the soil and culture, rather

than to the nature of the berry; even the "black-cap" brightens its hue on our rich meadow lands in the interior of the State. Again, on the more luxuriant vines of the richer soil it is readily seen that all the berries cannot be of the same dark hue with a crop of two hundred bushels or more per acre (which is only a fair yield), for such a crop cannot give to all the berries an equal chance at the heat and sunlight; and a part of the fruit, just as large, finely flavored and mature, will lack uniform color until after the picking and spreading in the store-house.

It has been said that the cranberry plant, if put on very strong land, will run to vines and produce little or no fruit. This, I am confident, is a mistake, if the bog is properly levelled and sufficiently sanded. Instead, the richer and deeper the soil beneath, the larger will be the crops, and the more continuous and the finer the flavor of the fruit. "Cranberry culture," as now understood, is comparatively recent in its origin, and is immense in its growth. I cannot, in the short time allotted to me this morning, give you even a bird's-eye view of the growth in the past fifty years, or less, since the culture began, or hint at the change brought about by this industry in the eastern part of this State and in a part of New Jersey, notably in three counties. The comparatively barren place has been made to bud and blossom and bring forth fruit delightful to the palate and peculiarly healthful as food. By it these poor soils have assumed a value far beyond that of the richest farming lands of the West, and have given to their owners not merely competence but wealth.

We will now look to certain requisites of location, methods of preparing the soil and training the vines.

The first requisite for a successful cranberry bog in the middle or western part of the State is water, — a good and sure supply for every emergency. In the spring, for safety from frosts; in the summer, for use against insect pests; in the fall, for security again against frosts, and in the winter for covering the vines. Therefore, an unfailing reservoir, or reservoir rights, or water rights (if on a mill stream), are absolutely essential to success, or to satisfactory results. Having the water supply secured, next look for sand of good

quality; that is, rather coarse than fine, and free as possible from loam or other impurities, near at hand and easily accessible to the bogs you propose to plant.

These two conditions being assured, you are ready to begin the work by perfecting a system of drainage, cutting the large main drains with sufficient incline to insure a quick flow when desired; into the main drains the cross drains should be cut at short intervals, to carry off the water after rains and to give the full effect of the sun's rays upon the growing fruit to hasten its maturity. Having the drains completed you are ready for work upon the bog, preparing it for its coat of sand. This is frequently done by levelling the inequalities only, and this may be sufficient and best on some Cape bogs. But on a meadow, with a subsoil of rich muck or peat, six, eight, ten or more feet in depth, and with the tenacity for life which some of our meadow grasses have, I think any bog will be more satisfactory in after years if it be smoothly turned over with a flat furrow steel plough, drawn by a steady, strong team, able to cut through any hassocks or roots, without flinching or overwork. The cutter of the plow should be drawing, or circular and rotary, of the best steel, and sharp as possible. These directions are for a grass meadow. Any other must be treated as the circumstances demand, so it is levelled; or better, slightly inclined from the center of each section toward the ditches.

You are now ready for the sand to be laid on, to the depth of five or six inches, — six the better. It is supposed this is on the border of your meadow, and if so, a portable tramway should be laid to the extreme part of the bog, that you may work back toward the source of supply. Circumstances must govern you in the method of hauling the sand to its place. On some meadows the incline is sufficient to require no draft to carry it, — only men or a horse to take back the cars. On the other bogs power must be used both ways. Generally the use of four cars will keep a good working force employed at the bank, by the quick exchange of the two by horse power. This part of the work can be done in the summer, fall, or winter (the sand being dumped in heaps and spread in the spring if frozen), or in the early spring; but this season should be, if possible, reserved for

setting the vines, which work should always be done in the spring, and for the best results, certainly not later than the first of June.

The setting of the vines I shall propose to do by the method called hill-planting, — the only one I shall describe this morning, though there are other methods that may in some cases be better.

The tools (all home-made) for the planting of the vines are first a marker, made of light material, to be easily drawn by a man, marking or indicating more or less rows as you please; next, a spud: to make this, take a round stick or piece of wood pointed at the lower end, about ten inches from the rather blunt point, bore a hole in this stick and drive in firmly a piece of strong wood projecting on one side about three inches, upon which to place the foot to drive it into the ground, making the hole for the planting; last, a dibble, or small wooden trowel, for setting the vines. These simple implements are sufficient for ordinary work, the marker leading and making straight rows, followed by the spud driven into the ground at each intersection, and carefully withdrawn that the hole shall not fill; again followed by a boy to carry and select and have ready the vines for the trusty and careful man to set them in the holes and press the sand firmly around them, which completes the work.

The vines should be fresh and thrifty, not allowed to wilt or shrivel, but kept moist or in water, till placed in the hill. They should be prepared by hand-sorting, to be sure they are clean from any and every other root or grass, and when cleaned, straightened out into ropes, and these cut into lengths of about nine inches (if the sand is six inches deep), and bound in blocks or bundles of convenient size (somewhat as kiln-dried kindling fuel is tied up), for the boy who shall accompany the planter. After being thoroughly soaked in water till they take on a bright, fresh look, they are ready for use.

Now the planter takes a small handful, — perhaps from a dozen to a score of the cut vines, — and grasping the top end firmly in one hand, places the square end of the dibble on the vines about two inches from the other end and

carries them down into the hole, being careful to leave the vines perfectly straight down in the ground, the tops being two inches above the level sand. These will quickly send out shoots and runners. In our inland meadows, — and it is for these I am giving these details, — the hills should not be less than eighteen inches apart each way, to assure the best results.

Thorough, careful culture, removing every root of weed or grass, is absolutely essential during the first and second years of growth, while the third year should give a fair crop of first-class berries.

One hundred and fifty bushels is a fair and average yield per acre, though a yield of from two hundred and fifty to three hundred and fifty bushels is not uncommon on our meadows.

Having our meadow thus planted and growing, what hinders it from being a continuous source of profit to the owner? It seems to be a fact that no crop of any value to the producer has yet been discovered that has not its insect pests, its dangers and its drawbacks,—and the cranberry is surely far from being an exception. The first point I will mention is the danger of variation of temperature. The bog is a source of constant anxiety from the day the water is drawn off (May 10 to 15) till the last berry is picked.

The water being drawn off, if conditions are favorable, May 15, the danger from the light frosts is not safely passed until June 10, and the susceptible, tender shoots containing the blossom buds must be carefully guarded, or the loss of the crop will be inevitable thus early in the season, for these fruit buds form in the fall and appear with the first signs of life in the spring. Then the frosts in the fall must be carefully guarded against. I do not think it safe for the owner of an inland bog to be off duty after August 15, though it is very seldom that the frosts to injure a sanded bog come before the 25th of August. The past season, the frost of September 6, so severe as to affect the Cape and Jersey even, proves the need of a full supply of water, and that the cranberry grower must be constantly on the watch to save his crop. The green berries are very susceptible to frost, growing more hardy as the fruit matures.

To illustrate: the frost that was so destructive to the crop this past fall, September 6, would have had little or no effect had it occurred September 20, or 15 even,—the ripened berries would have withstood the same degree of cold without harm.

Next, insect pests. The cranberry grower soon learns that his culture is not exempt from insect enemies, the miller and its result—the fire-fang, the fruit-worm, the cricket and the grasshopper—each comes in its season to add to your care, and to demand your immediate attention to save the crop. The unfailing remedy is water, best applied when wind and current will unite to waft all insects safely over the dam as you let the water off; for the insect pests that are carried over the dam never come back to trouble you again. It has been thought that a decoction of tobacco sprinkled over the vines will stay the ravages of the fire-worm, but I did not find it efficient in my experiments with it the past season. If this shall succeed, or if the remedy can be found that shall destroy the miller, and consequently the fire-fang, on meadows that have not the benefit of water, it will be of incalculable value to the many growers who are obliged to stand by and see the promise of a golden harvest vanish before their eyes, with no power to stay or to save.

The picking is done by hand, costing from forty to sixty cents per bushel, and a good, smart picker will earn from a dollar and a half to two dollars per day, while the average picker will make from one dollar to a dollar and a half, the day being about eight hours long. There is no more beautiful crop raised than the cranberry. The bud and the blossom are "a thing of beauty," and the well-cultivated bog is, from about June 15 to the close of the season, very attractive and enticing, but most so as the fruit approaches maturity, taking on its crimson tint, and hanging from its little pendant stems, one berry above another crowding for the sunlight and the air and the heat, as though hastening to mature itself before the coming of the frost.

The question now to be settled is the final one, and the important one of profit and loss.

As we have seen, the cranberry is an American plant. It has not taken root in other countries, nor has the fruit been

received with favor in Europe. They neither know how to cook it there nor care to eat it, and therefore we have no export demand for this fruit. There was a stock company of cranberry growers formed to export and introduce the fruit, and create a demand for it. An agent was sent out to show how to cook it in the various ways, and to furnish the hotels with the sauce properly prepared to excite the palate and induce a call for it; but I think it was a failure and was abandoned. Therefore, as we learned to our sorrow one recent year, we find no export demand to relieve the market; and our only recourse for an over-supply is the "dumps," and in such a case the sympathy between the cranberry grower and his fruit is marked, if not gratifying. This fact certainly should have place in our calculations at this point.

"The cranberry business," says White, "is no longer looked upon as speculative. It now takes its place as an industry that will make good returns for well-bestowed labor; but, like any other business, to be pursued profitably, it must be conducted on right principles, and with strict attention to details. Some, from a peculiar knowledge of what was required, and others more by a good fortune than good management in selecting a locality, have achieved brilliant results; but many have failed, and many are now entering the business who will be disappointed."

If this was the case, then, when the price of the berries was from nine to twelve dollars per barrel, it cannot be more favorable when from five to seven dollars is a good price per barrel delivered in market. It would not be fair to determine the profits of this culture by the very unsatisfactory year just passed, or by the present unsatisfactory prices of the market, — the result of the condition of the fruit, caused by the frosts so extensive and destructive; the attempt to save berries and reduce the loss has in many instances resulted in the greater loss to the individual producer himself, and certainly to the great body of producers. Under the favorable conditions of the Cape, good bogs with sufficient water supply will usually be very remunerative. The conditions are more favorable than in the interior; the grasses are not so persistent and aggressive; the frosts are not so late in the spring or early in the fall. They can pick the

berries more leisurely and market them from the bog. So we find it true that the cranberry on the Cape is, and will probably continue to be, very profitable. There can be little doubt of this. Then the question comes to us in the interior of the State, Taking circumstances as they are, is it a sufficiently remunerative crop for the extra hazardous nature of the investment? Given the necessary conditions to success, I believe it may be made so, and should be encouraged, not in expectation of enormous profits, but anticipating fair returns for the money invested, unless over-production should result in loss to all engaged in this legitimate branch of agriculture. With the knowledge brought to us from experience and careful scientific experiment, we may reasonably hope that many obstacles to present success in cranberry culture in the interior of our State will be overcome.

The CHAIRMAN. Gentlemen, you have heard this interesting essay on cranberries on dry land. Mr. Stockwell will be pleased to answer any questions or take up any points, and I should hope that the people from the Cape especially would have something to say.

Mr. WARE of Marblehead. There is one point I do not quite understand. I understood from the essayist the importance of rich, strong and deep bogs; and then that they were to be covered with six inches of pure sand without any soil. I want to inquire whether the cranberry's delicate roots reach down through that six inches of sand and draw their nourishment from the rich bog underneath? The inference I drew from the paper was that they did; but I did not suppose the roots of the cranberry-vine, being so delicate, would reach to that depth for nourishment.

Mr. STOCKWELL. I stated in the essay that the vine should be cut in lengths of from seven to nine inches; the dibble placed upon the vine about two inches from the end so as to carry it down through the sand to the loam below, and from them come out the shoots and runners; therefore, you have roots at every one of these intersections below the point where the cranberry-vine strikes the loam. The little roots from the runners do not reach the loam.

Mr. Ware. Then I understand the crop is dependent for its food upon the roots that go down below the sand?

Mr. Stockwell. I did not intend to have it so understood, because I said the peculiarity of the cranberry is that most of its life is drawn from the air and water.

Mr. Ware. Then the point I want to get at is, is there any advantage in a rich bog under the soil over any other, for instance, a gravelly subsoil, or any subsoil that might be under the sand?

Mr. Stockwell. I think there is an advantage, the advantage that we find in every crop that is raised upon rich land — a difference in flavor. There is just as much difference in the flavor of the cranberry as there is in the flavor of the apple; and yet very few people know it. Now let me illustrate: At a meeting of the Union Agricultural Society in our town we had two distinguished speakers present, whom you all know, who have attended these meetings very frequently, and upon the table was cranberry sauce. They at once remarked upon the peculiar flavor and character of the sauce; they never had tasted any like it; they were not particularly inclined toward cranberry sauce; but from that time to this each one of those speakers has had a barrel of cranberries from the inland bogs, and takes no other.

Mr. Cushman of Lakeville. In continuation of this thought I would like to make inquiry. I notice in many bogs of the Cape they commence at the shore and dig back on a level plane, carrying the sand upon the bog. Some utilize this land where they have dug, and others do not. Now, I would like to inquire of the essayist whether he would set vines upon that sandy soil that has no mud underneath?

Mr. Stockwell. I certainly should, because you would receive fruit from it; but upon such ground it would be necessary to find some fertilizer, while upon other land it will not.

Mr. Cushman. This would be flooded, you understand, the same as the bog.

Mr. Stockwell. Certainly you will obtain a crop; but you will need to use some strong fertilizers, I think, for good fruit.

Mr. Edson of Barnstable. I reside in a cranberry-grow-

ing region, and am somewhat interested in the cranberry business. We consider the Early Black the best, for several reasons. They bring a better price, they are ripe about two weeks earlier than the lighter colored berry, and so escape the frost to a great extent. They are not quite as large, but they are more solid. Open one of those early black berries and you will find it a full, solid berry. Open those light colored berries, larger in size, and you will find they are very open, very hollow. They do not make as much jelly or cranberry sauce as the darker berry. I like to see a good dark red in cranberry sauce.

It is not absolutely necessary to be able to flow the bogs at any time. I presume nine-tenths of our bogs on the Cape have no facilities for flowing in the summer season. We can let the water on in the fall, and keep it on as late as we like, but we can not replace it except we have a shower, and that does not come when we have frosts. In regard to making a bog, I will admit that in the interior the plan of the essayist will be proper. I will go further. I think it would pay to bog that piece; take off every particle of the turf so as to get the roots out of the way entirely. They are persistent in coming through, unless you put on six inches of sand; and then they will come through occasionally. The idea of putting on so much sand is merely to keep out the foul stuff. Our best cranberry growers have a very large income. We tax the bogs when they are first made at about $1.50 an acre. Then as they come into bearing our assessors cause the growers to make their returns every year of the number of barrels taken off of those bogs, and they are taxed according to their product; and I think they are pretty well taxed.

Mr. Sessions. Will you state about how high a valuation they attain?

Mr. Edson. Well, we value them up as high as one thousand dollars an acre when they produce a full crop. The best crop we ever had was nearly two barrels to the rod. If we get a barrel to the rod, or one hundred barrels to the acre, we consider it a very good crop. In making a bog, I would advise any one, even in the interior, to take off every particle of roots and grass and rushes that are there. It is something of a job, but if you will take that trouble it will

pay in the end. What is taken up will make a very good absorbent to put in your cow-yard, and you get partly paid for the expense in that way. Then, instead of putting on six inches of sand, I would put on only three. The cranberry does take its nourishment from the peat below the sand, there is no doubt about it, and the cranberry root does not want to go six inches down. They do not do as well in six inches of sand as in three; it costs much more to put on six inches of sand than three. Our cranberry king says if your bog is likely to be weedy, put on four or five inches of sand; if you are clear of all the turf and weeds, he does not want over three inches. I am talking only of the Cape. You want your bog very level. We ditch in sections about five rods wide, making a ditch about eighteen inches wide, and deep enough to carry off all the water. We want to keep the ditch nearly full, within about five inches of the top, and if the sections are more than five rods wide, the center of your section will not do as well as that which is nearer the water. When we get on our three inches of sand, we work it perfectly straight both ways, and at the intersection of the lines set the vines. We want the runners from two to three feet in length. We take a dibble, and one of those long vines, and place it about four inches from the center of the cross. Run them clear down into the mud below, so they will go two or three inches into the mud. It will branch or sprout readily. We set them around in what they call flower-pot style in that section. We find that plan of setting does the best. Women do that work a great deal, and do it very nicely. It is good clean work, and they like it, and make good wages, and we can always get them. We have tried raking in the vines. They will start and grow, but you cannot weed them. The first year they need hoeing three times, because no matter how clean your sand and gravel, it is astonishing to see what will grow. Clover and weeds will come right out of the gravel, and you will be kept pretty busy keeping them down. They seem to start from the sand, and when you get the bog made, there is a good deal of trouble in keeping it clean. You have to go over it three times a year for the first two years. If you allow the grass to get the start you may as well give it up, and bog it

over. A gentleman said to me, "I have paid a dollar a rod this year to keep one bog clear of weeds." You can make a bog for a little more than that. It will cost in our cedar and maple swamps about two hundred dollars an acre to prepare a bog if you have your sand handy. I think we can put sand or gravel on the bogs cheaper with barrows when we do not have over one hundred and fifty paces to wheel it than we can with a horse. Men will go very quickly with barrows, running them on planks just where the sand is wanted. It spreads very easily and much more evenly than if it is put on with a cart. I am making five acres now, and they will cost me just about two hundred dollars an acre. The plan described by the essayist may be best for the interior, but we find that our plan is best for us.

Mr. Cruikshanks. How long will these bogs remain in bearing condition without bogging over?

Mr. Edson. There is the advantage of putting on a little more sand. If you put on four inches of sand, it does not require rebogging or resetting as soon. If you put on but two inches of sand, it runs out sooner; but then they have a plan of putting sand on the vine, about an inch of sand right over the vine in winter.

Question. Do you recommend that?

Mr. Edson. I think it is a good plan. The third year you ought to get the best crop, and it ought to pay for your bog, and leave you a pretty good income besides; but after that, the fourth or fifth year, it would be better to put on another inch of sand, and then your bog will go on better than with fertilizers.

Question. Go on forever without re-sanding?

Mr. Edson. No. After a while the vines may get rather weedy and run to a very heavy growth of vines. We have had a good deal of trouble there this year with frost, and the cranberry association are talking very strongly of canning those berries or making them into jelly, putting them up in glass jars. Many housekeepers say they had rather have the frosted berries to make a jelly of than the other. Mr. Small of Harwich told me he had a thousand barrels on his bog he would give to any one that would pick them. There would be a thousand barrels to put into cans. I

believe we can find a market for the canned fruit and jelly. Almost every lady would rather have the berries all ready to put on the table than to put them up herself.

Mr. ——. The essayist says two distinguished gentlemen found the sauce at Sutton very nice. I would like to ask him if it does not make a little difference how you cook the cranberry, what you mix with it. It strikes me there may have been something in that. Poor molasses or poor sugar makes a great difference.

Mr. Stockwell. I should prefer to leave the credit of it with the berry. My friend Mr. Edson speaks of the Early Black. He does not speak any too highly of the berry. If I was going to set out any berry on an inland meadow, I would take the Early Black. It is the earlier fruit. And then when you take the black-cap of the Cape, and bring it into the interior, it takes on that bright hue that is so much superior to the dark shades of the Cape berries. No doubt the culture makes a great difference in the weight of the berry. Large berries such as we raise will outweigh any other berry that is grown upon natural soil, or that does not have the right culture. On the Cape they do not need the water usually, but that is essential and necessary for us in the interior. They have not the frosts that we have. They can more easily pick their berries, because it is very seldom that the early frost that troubles us touches the Cape bog or Jersey bog, therefore they can get along without the water. But my friend Mr. Edson speaks of the water as necessary, and the ditches as filled to help mature the crop. It is exactly the opposite with us. We want all the heat we can get from the sun in order to mature the fruit. On the Cape they desire the water in order that the cranberry may grow to a good size. But it is exactly the opposite with us, so there is no comparison.

Now, with reference to hill planting and taking the turf off. That may be in certain cases advisable; it depends upon the character of your meadow. If it is nothing but grass or roots or brush, you might do it, but you are not going to get rid of the persistent grasses by taking off the turf, because their roots remain; and Mr. Edson finds them in the sand. They are coming up through if you put on

your two or three inches of sand. It won't do, by any means, in the interior of the State; six inches is better. When you do a thing, do it well. Then, in the interior of the State you are not obliged to re-sand, if you keep your grasses out, neither are you obliged to fertilize; you have it all there for an indefinite period of time. If your vines get too bushy, cut them off, or take out part and let them grow again. If you do that, nothing more is needed.

Now, in reference to planting. I set eighteen inches apart right down through into the rich meadow mould. That is what all Cape growers say is dangerous. They say you should not have a rich soil because they run to vines. If you will plant them eighteen inches apart and give them a chance to get at the rich soil you will not be troubled, because your runners come from the sand, therefore you are saving the meadow from a superabundance of vines and are getting a crop. Now, in reference to the crop. The interior will give as large a crop as the Cape. As to the grass, I was speaking to one of the largest cranberry growers in Plymouth County, and he said he would not take a grass meadow as a gift. That is the opinion held in many parts of the Cape, because of the persistency of the grass. Nevertheless we find them profitable, and if we could be sure of security against frost, and had a proper supply of water, it is as safe to plant in the interior as on the Cape. The method of setting vines which Mr. Edson has described may be the best on the Cape, but I do not believe it is in the interior, for the reason that, for the first two years, if set as I recommend, a dozen or a score of vines coming up in their place and runners starting, you can cultivate and keep down the weeds with much less expense.

The Chairman. The time for this interesting discussion has expired, and the discussion will be continued at the hotel between Mr. Edson and Mr. Stockwell. We are now to take up the next subject, which is on the cultivation of the apple, one of the most essential fruits of New England. We are disappointed in not having a paper to be read on the subject, the occasion of which the secretary will explain.

Mr. Sessions. On the twenty-seventh of last month, too

late to make any definite arrangements, we received a line from Mr. Brown, who was to speak on the Apple Orchard, saying that owing to ill health he was unable to deliver the lecture. Yesterday I engaged two Connecticut gentlemen to occupy his time, who will do it well, — Mr. P. M. Augur, State Pomologist, and Secretary T. S. Gold.

THE APPLE ORCHARD.

Mr. Augur. I will only touch upon two or three points, as the time is limited. And first, the great value of the apple. We could not well do without it, and its use, we all admit, should be greatly increased. The question may be asked, What land shall we use to plant apple orchards upon? All agree that fertile land near our large cities, near good markets, and where land is called for for market gardening, is too valuable to plant apple orchards upon; and again, we find that by going back a little from the cities and taking the land, if I may so speak, on the back hills, elevated land, land with a strong soil, and a retentive subsoil, we get our best locations. We find in Connecticut that orchards planted on such land are more durable, that is, they last longer. I was told a few years ago by an old distiller who lived in one of the towns in a farming community that he knew it to be a fact that cider made from orchards on this retentive soil, would yield one-third more brandy than cider from orchards on the plain where the land was sandy and light. The fruit is richer, its keeping qualities are better, unquestionably so; and for that reason, considering the lower value of those lands, and their greater value for apple orchards, we should naturally choose such lands for planting apple orchards.

Now, having said so much, suppose we ask the question, What shall we plant? Having selected our site for an orchard, which I think should be one that can be cultivated, what shall we plant? I am not going to say anything about varieties, but we will take the ideal tree from the nursery. If I should plant an orchard, I should want to get an ideal tree, and then select the whole orchard to conform to that ideal. Many orchards have only a few good trees, a great many leaning trees, a great many dwarfish

trees. It is seldom that we see a good orchard; but if we will select nursery trees that are grown from first-class seedlings we shall make a good beginning. And if you choose grafts, be sure that a seedling stock shall make only one tree, that we make that tree on a stock which has the center of vitality in it instead of buying a fragment of some side root. There are a great many root grafts that are imperfect. We should select trees that are budded on first-class seedling stocks. Then I would have a tree, which, when you take hold of it in a nursery, seems firm, well balanced with roots, not with the roots all on one side. Select them all as near as possible after one model, and let them head. My own idea is they should head from five to five and a half feet from the surface or possibly six feet, but I would not have them less than five or five and a half feet, in order to give better opportunity for cultivating in the orchard. We have some trees that head lower than that and it is a great annoyance to cultivate under them, therefore I would select them after such a model, and if trees are entirely selected with well-balanced stocks, you may set an orchard of five acres, and at the end of fifteen years have likely trees. It is a point greatly to be desired, to have a perfect orchard.

Another point that I would allude to is the matter of cultivation. When we plant an orchard we should endeavor to secure a good start the first year, precisely as we would if we were raising stock. If we have a nice calf, we want to keep that calf growing right along from birth to maturity. If a tree gets a very decided check, at transplanting, or within a year or two after, it is more difficult to get it started again and recover the time. It is best for mulching and for cultivation if the trees are well transplanted. We want to get a good growth the first year, yet not an overgrowth. I think there are two extremes that we should avoid, one is starvation, and the other is excessive growth. I remember within two or three weeks seeing a little item in the "Homestead" that attracted my attention, in regard to a peach orchard where the trees had died, or at least portions of them had died, near the ground, and the question was, what was the matter with them? Of course I do not know how that orchard was managed, but my first impression was, and

I presume it was a fact, that there had been an overgrowth on those trees, that the growth had been prolonged late into the season, and before the bud had become fully matured a frost had come and destroyed the cambium layer, and that a portion of the tree near the ground had been injured. Peach orchards are very often destroyed in that way, and pear trees as well. I recollect in my own experience a pear orchard where we planted currants between the rows of pear trees, and after getting a crop of currants we renewed the cultivation in the fall. We had a part of the orchard devoted to Clapp's Favorite, and we noticed we had a later growth on those trees than we desired, particularly as that variety is a very free grower. Well, the consequence was, that in three or four years these trees all failed. I think it was not the orchard pear blight, but the trees suffered from too much growth, the wood did not mature well, it did not harden up good. So in regard to the apple. I think this is a point we should avoid. I have in mind now an orchard in our city which was in its time called the best orchard in town; the land was devoted to onions, and highly cultivated through the season, and those trees made an enormous growth; it was remarked by everybody. But there came a time when the onion crop was discontinued, and it was laid down to grass; and the revulsion was so great that those trees at once received a shock, and from that time the orchard began to go down. I think there had been too great growth, the wood was soft, spongy, and the trees failed very quickly.

Now, in reference to the apple orchard, I think if we can adopt that idea and make haste slowly, keeping a good moderate growth, never an excessive growth, not cultivating the ground late in the season to get a protracted growth, that we shall go on and get our orchards in good shape, and the trees will be probably remunerative.

I will allude to just another point, and that is the matter of pruning. Here I think we make more mistakes than in almost any other point. We take this ideal tree that I have spoken of and plant it, after having smoothed off the ends of the good roots carefully. Then let us look at the head. I prefer trees that are three years old, and that have commenced forming a head. Very often we shall find that three-

fourths of the top which has been formed should be taken off. We want perhaps four, or possibly five, branches to be main branches of the tree. Let us take out everything else. Let us not raise an indiscriminate top of tangled wood to be sorted out after the branches grow, leaving large scars where rot will commence, from which the trees will suffer. If we could prune our young orchards, beginning at the start, taking out everything superfluous, following it annually, never forgetting for a single year to take out everything which is not needed, we should have shapely trees, no badly snarled specimens, but trees that will go into bearing in perfect form and in perfect condition, and we shall find that we have saved time, and saved in every way by so doing. The trees will commence to bear sooner, and bear more perfect fruit, and the result will be more satisfactory to all concerned.

There are other points, but I will leave them to Secretary Gold, who will speak of them from experience. [Applause.]

Mr. T. S. Gold of Connecticut. What is one going to do when the time is already exhausted before he begins, and when, as in my case, I have not done anything or thought of anything but how to handle an apple crop for the last three months? You must excuse me if my remarks are entirely in the way of reminiscences of my observations with regard to the apple tree and its fruit.

Now, with regard to the question whether we should cultivate orchards, and how long we should cultivate them, I do not propose to speak; but I want to call to your mind the fact that all the great bearers that you remember in every town in the Commonwealth are trees that stand where they have had by no possibility any culture from the time they were planted. They are trees that stand in some rich, deep, strong, fat corner of land, so protected by fences or otherwise that they have had no culture. Their roots have been allowed to run near the surface. Their growth and fertility has been promoted by the droppings of the cattle, or the natural setting towards them of the surface of the land. You see old, magnificent trees that sometimes yield a hundred bushels of fruit, and are alive and vigorous to their extreme branches. This may enable you to form conclusions with

regard to the manner in which you should treat an orchard. The most poverty-stricken orchards that I have seen are those that are in fields which have been made to yield crop after crop, and last of all a few crops of rye, because no other grain would grow there; and all this time farmers are complaining that the orchard does not pay.

With regard to varieties, I will have a word to say. For market purposes the fewer varieties you cultivate the more comfortably off you will be in disposing of your crop; but if you wish to have apples every year, a continuous supply for your family and a continuous supply for the market, it will not do to rely upon one, two, three or four varieties. With a large number of varieties you will be quite sure of a continuous supply; very remarkable seasons excepted. If, in addition to planting a number of varieties upon your farms, you will select a variety of locations for your orcharding, not putting all your eggs into one basket, so to speak, by having the orchard all in one location, exposed to the same influences of weather, affected similarly by drouth or excessive wet; if instead of this you distribute your orchard somewhat upon your farm, you will score another point in having a uniform and continuous supply. It has been my experience that whenever a new variety has been recommended, I have been anxious to secure it, and I have added to my varieties until now I have probably over one hundred kinds of grafted fruit growing upon my farm. The annoyance and confusion that results when we are gathering fruit, to keep the different varieties in the proper places, is very great, to say the least. But it is very satisfactory when some varieties that are very rare and difficult to produce, and which do not produce a perfect apple once in five years, bloom out upon you with most perfect fruit. It is wonderfully satisfactory to be able to produce a dish of the old-fashioned Pearmain in its beauty and glory. You feel as though you had done something; although it is one of those things which you can not account for. Providence has favored you, in addition to your own labors, with temperature and climate and conditions just right to enable you to do it; but there is very great gratification in it, and if you seek supreme gratification in fruit culture, apple culture especially, you

will, of course, delight yourself with a large number of varieties. But for the market the Baldwin and Greening are standards most reliable here in New England. The Baldwin has a habit of failure upon certain light soils, — upon the gravelly soils in our valleys. Upon our hills, with their heavier soils, it is as hardy as any of our forest trees. The Greening is sometimes discarded in certain places, but I think you will agree with me that, take it one year with another, you can pick as many bushels of good Greening apples in a day as you can of any other variety. The Baldwin, under peculiar circumstances, will bear more abuse and rough handling, and under certain circumstances you will gather more bushels of Baldwins; but the Greening grows larger, fairer, less seconds, and less waste, and as the market demand is this year, it stands better than the Baldwin. The early apples — the summer apples that are so often wasted when we grow them — find a very fair market in some years. This last year was an illustration of that fact. Our early apples — the William's Favorite and the Porter and the Pippins, that variety of early apples suitable for cooking — bore a price in our market that was better than we are enabled to get to-day for the leading winter sorts. We had no competition this year from New Jersey and Long Island, a section of country that often spoils our early apple market. It is often the case that these early apples won't pay for harvesting and sending to market. This year they have paid better than those that are going to market at the present time.

I would say a word to some of you that may not be familiar with our system of selling apples; that in our section of the State of Connecticut the supply has been very abundant on the hills this year, and apple buyers have taken advantage of the fact, and they come and buy the fruit by the carload. The farmers agree to deliver the fruit just as it is picked from the tree. They agree to pick it, not shake it off and bruise it, but they do not reject many of the small ones. They take pretty nearly all of them, and the farmer delivers them at the car at eighty-five cents a barrel. He empties his barrels into the car. Well, that seems pretty small compensation, and the report that apples in such a section are

only eighty-five cents or a dollar a barrel leads people who have no apples in their parts of the country to send there, expecting they can get apples put up in barrels delivered at the station for about eighty-five cents; but that is a business of quite another character. We have to pay thirty-five cents each for new apple barrels to put up our crop in, and to sort them carefully into seconds and thirds, and head up the barrels, is quite another business than what it is to take them right from the trees and transport them directly to the cars and pour them in. The agent is not the seller in New York at all, and he has to handle a good deal of indifferent fruit. Those who dispose of their fruit in that way have had a very handsome receipt, perhaps of a couple of hundred dollars, from an orchard of an acre or two. This they have secured by their own labor, and that of one or two men in a week's time spent in gathering. They made a very fair thing at that very low price.

We ought to have apples for family use the whole year round. It is not at all difficult to accomplish it, and have the apples in good condition. We never expect to be out of apples. We expect to have old apples until the boys prefer the fresh green ones. Let them be placed in barrels, or boxes, or bins, in a cool cellar, one that is not very dry is preferable. The cellars upon our hills all have water rising in them and flowing off in drains, hence the apples rarely shrivel up. We have found very great advantage in the last few years in thoroughly whitewashing the cellar. Some new cellars that never had been used before, with an abundance of paint and mortar all about them, furnished apples in spring of fine flavor, excellent quality and purity of color; taking a hint from that fact, we have found that a thorough cleansing of the cellar, and the abundant use of whitewash on the walls, is a very great help in preserving the quality and in keeping the apple from decay. Now, if you want to have the perfect flavor of the apple retained, do not put your apples into a cellar in which cabbage and turnips and strong-smelling vegetables are stored, or where you keep codfish and kerosene, or other grocery articles; for if they do not affect the flavor of the apple, they do detract from its pure and finest aroma. Keep them in a clean cellar, as cold as

you can, as near the freezing temperature as you can, and put them into the cellar in a sound state, right from the tree, without any extra handling. You need not disturb those boxes or barrels or casks except as you want to use them during the winter or spring. Every time you handle them you injure the keeping qualities and the perfection of the fruit; and if they are put up sound, free from bruises, each variety will arrive at perfection at its own peculiar time. You need not disturb your later keeping qualities at all. Use the Pippins and Hubbardstons, or any kind that you please, in the early part of the season, and later come to your Baldwins and Greenings and Russets that round out the year. The apple, as the farmer's fruit, should be upon his table in the raw state, and as an article of sauce or food, every day in the year; and I do not know but it ought to be there three times a day. It is sometimes crowded out by the pressure of other things; when the fresh strawberries and some fruits of that kind come on, the apple has to give way for a time; but it is susceptible of being prepared for the table in such a variety of ways, and for such a variety of uses, that it is the cheapest, the most economical, the most healthful, and the most pleasant article that you can add to a farmer's table, or anybody's else table, in profusion.

There is nothing that will so tend to the healthy development of children as the enjoyment of all the fruit they choose to eat, from morning to night; only let them begin early, so they will never hurt themselves by eating to excess. If it is begun early, they may eat them morning, noon and night with perfect satisfaction and healthfulness and enjoyment.

You will excuse me for having taken up time that did not belong to me in these few rambling remarks. [Applause.]

Mr. Peterson. Where the mistake has been made of setting apple trees too closely, so that the branches interlock and prevent the sun reaching the fruit, what is the method of treating?

A Voice. Cut back and thin out the branches.

Mr. Gold. I have been advised to try that practice, and I have tried to do something at it, but I made very little progress. I could not instruct my men to do it intelligently and satisfactorily, and I have done nothing at it except a

few little preliminary attempts. But one thing I want to say is, I can raise better apples, and I am going to do it. I have let apples grow, and sometimes had very good ones, and sometimes very poor ones. Some of the difficulties connected with apples I do not know anything about, and I cannot understand them. One is the apple maggot. I do not know how to combat him. I got an apple from the hall below to-day, with a fine red cheek, but this contemptible fellow had got ahead of me, and it was a worthless apple. It is very disgusting to find him infesting our fruit, but there are some things I believe we can meet. I believe we can successfully combat the coddling moth. I have made some efforts in that direction, and I only blame myself that I have not been more thorough. I calculate to follow them up more thoroughly until I become master of the situation in that direction. There is abundant testimony that Paris green is useful, and I intend to try it more thoroughly than I have in the past. I would advise setting out trees not less than forty feet apart, and giving them a chance to grow. When a tree gets to be twenty-five years old, it is just in its best condition to bear the best fruit and the most of it; and then after they get into the habit of interlocking branches, as has been referred to, it is very annoying and unsatisfactory.

Mr. Atkins. What are some of the best new varieties? Are there any that are likely to become standard market varieties?

Mr. Gold. I have no very great experience with these newer varieties. I have grafted some of them, and have had some fruit, but the whole thing is rather in the dark with me. The King is a very remarkable and fine apple in some respects, but as far as I can learn it has proved tender and delusive; very few trees ever get into good bearing, they very soon begin to die, and it is an unsatisfactory apple on that account in Connecticut.

Question. It is not very productive?

Mr. Gold. Perhaps so; but I have seen some trees bearing very well.

Mr. Cruikshanks. Have you had any experience with the Transparent Yellow? That is one of the Russian apples.

Mr. Gold. No, sir.

Mr. Cruikshanks. I have had a few of them. It is the earliest apple that I have ever seen, of a good quality, large size, somewhat the shape of the Porter, larger than the Porter, I think. It is bright yellow. It is not nearly as acid as the Astrachan, and from ten days to two weeks earlier. At the Pomological Society's meeting a year ago last September, Dr. Hoskins of Vermont pronounced it the best early apple which he had.

Question. Does it come into bearing early?

Mr. Cruikshanks. All the testimony that I have is, that it is very early, and a superior apple for the market on that account. Dr. Hoskins said it could be planted much nearer together than some others, because it grows so compactly.

Mr. Palmer of Groton. I am sorry this discussion has to come to a close; as I understood the Secretary, the time is up. I am very much interested in the raising of apples. If I have been prospered at all in farming, I owe my success to the apple crop; and I was delighted to hear the first gentleman state his views in regard to setting out an orchard. I have set out three myself, and one orchard I selected in the very same manner he described, going to the nursery myself and picking out just the trees that I wanted, paying a few cents more for them. I set out ten acres in that way. I trimmed them in the way he spoke of, except that I left three branches instead of four. The orchard is twelve or thirteen years old. I picked this year on an average a barrel to a tree of Baldwins; some trees bore a barrel and a half. I have never put a saw into the orchard; never used anything but a jack-knife. I trimmed them to three branches. Then I watched them for the first few years, and whenever a "sucker" or branch came out, I cut it off on the inside. I think the trees are nearly perfect in their shape. There have never been any large limbs on them. The advantage of starting an orchard in the way he described is that you do not have to come in and murder it with the saw. I have not cultivated the ground except for an ordinary crop; that is, I have ploughed it, and planted corn, seeded down to grass, and it has been treated in that way

just as any other part of my farm. The land is some of the best I had on my farm, on a side hill. Do not plant an apple-tree where nothing else will grow; if you are going to get a good orchard, plant it on the best land you have. Take a side hill, if you have it, because that is the best drained. There are a good many things I would like to say if the time was so that I could. We raise in our section quite a large lot of early apples, the Early William. I sold them this year for two dollars a barrel, and the man took all I had at that price, which is more than we got for our later varieties. We began to sell our late ones to shippers at a dollar and a quarter, and finally got down to a dollar a barrel, and even at that low figure I think there is more money in apples than anything else. That is, we get almost as much of everything else, and our apple crop besides. Now, in the little farming town that I live in, we have shipped somewhere from twenty thousand to twenty-five thousand barrels, which means about one-half of the money they brought extra to the farmers of that town. If they had not raised those apples they would not have raised anything else to have taken the place of them; and I advise every young man who is going to commence farming to set out an orchard the first thing he does, and take good care of it. Do not grow your trees fast; do not get to thinking you want the land for something else; and do not neglect it so that it will die. I suppose there are a great many orchards that are grown too rapidly. The trees are very large. You do not want them very large; but you want the tree trimmed, to start with; then let it branch over so you can pick two or three barrels when it is loaded, by standing on the ground. I picked eighteen hundred barrels of apples this year, and I am confident that in no other way could I have got as much money as I did for my apples, and money is what the farmer wants. That is the very point to-day in farming. [Applause.] We want to raise crops whereby we can get more money. My apples have averaged me for the last fifteen years twelve hundred dollars a year. We want to have more money; if we cannot get it in apples, get it in blackberries, strawberries, small fruit, or something of the kind. We want to carry on our other farming just the

same. Then we want some crop for the money. Our farmers want money just the same as the manufacturers and merchants; we want our boys to have money; we want them to dress well and have a good team to ride in; and we want them to have so much that they will stay on the farm. [Applause.] And we want to so conduct farming that they will consider it the best business in the world, as it is the best business to-day. A young man with brains, if he has two good legs (which I have not), can make money in farming right here in Massachusetts. [Applause.]

Mr. Gold. The gentleman asked a question with regard to fertilizers upon these orchards. I use all the wood ashes that I can get in my vicinity to strew upon the surface in my orchards. If I could get more, I should use more. I top-dress also with barnyard manure a few acres here and there, as the case may be, every year, and I know that the top-dressing upon the orchard pays me as well as any other use of the manure to which I could put it. There is one case in our neighborhood where an orchard was top-dressed with muck from a swamp, and the result was most marvellous for two years; but barnyard manure as a top-dressing is the best, I think.

Mr. Augur. I beg your pardon for taking up any more time, but the question was asked in regard to new varieties, and in regard to any becoming new standards, and I would like to say a word. I was down in Maine last winter at the meeting of the Board of Agriculture, and there was one variety there that absorbed more time and more interest than any other, and that was the Red Russet. I presume you are familiar with it. It seemed to be the idea down there that the Red Russet was the coming apple for shipping, and the chief points in its favor were, first, that it was so vigorous a grower, a handsome grower, as much so as any other; again, that the fruit was a good keeper, very good, fully equal to the Baldwin, and perhaps better; and then again, one of the shippers who had shipped to Europe said that he began shipping those Red Russets as Baldwins; they took in the English market, and said he, "If I was going to ship again, I should ship Red Russets." Well, that is a straw which shows which way the wind blows. I have a good deal of faith in

that variety, although it has not been very widely disseminated. It is being called for in Maine more than any other variety. In regard to the Yellow Transparent, I believe everywhere that has been tried and proved, it has been very satisfactory. The tree is not a rampant grower like the Roxbury Russet or Baldwin, consequently can be planted very closely. The apple is very satisfactory, and the time of ripening earlier than the Early Harvest. As a family apple we have nothing to compare with the Primate. It is superb if the tree is grown in good land and properly treated; but with almost all these tender apples, it has become a necessity to use a great deal of care on account of moths and worms; but I have confidence that if we make three applications of Paris green, or London purple, or white arsenic, and in the right proportions, and at suitable intervals, bringing the last application when the fruit has attained some little size, we shall escape largely the effect of the blue maggot, although there is some question about that. Last year we were pretty thorough in spraying our trees, and varieties like the Hurlbut, and some of those tender apples, escaped, where we had before been seriously troubled. I cannot say it was due to the spraying, but I suspect it might have been.

QUESTION. Is the Red Russet entirely a new variety?

Mr. AUGUR. The Red Russet is not altogether new. It has been known a good many years, but has not been widely disseminated. It originated in New Hampshire, and has been represented as a cross between the Roxbury Russet and Baldwin. It seems to be the idea that it is a sport from the Baldwin.

QUESTION. Is it known by any other name than the Red Russet?

Mr. AUGUR. I do not know that it has any synonym by which it is known widely except Red Russet. That is the principal name, at all events.

The CHAIRMAN. The next paper will be upon "Strawberries and Currants for Market," by a gentleman of large experience in that direction. He is well known to you all, — E. W. Wood of West Newton, a member of the Board.

STRAWBERRIES AND CURRANTS FOR MARKET.

BY E. W. WOOD OF WEST NEWTON.

The profitable growing of the small fruits depends more upon location than the tree fruits, being more quickly perishable and more liable to injury in transportation. A home, or not distant market, is a matter of importance, and as the cultivation of the small fruits, as well as the gathering and preparing for market, requires much more labor than the ordinary crops, the opportunity for securing suitable help when needed, and at reasonable wages, is to be considered. This is especially true of the strawberry, as the time for gathering the fruit is limited, and any considerable delay in picking when in condition, will result in serious loss.

The fears entertained a few years since by the strawberry growers that the constantly increasing supply of this fruit from the Southern States, anticipating the native fruit for the space of three months, would seriously interfere with its production in this State, have not been realized. The demand for the native fruit has constantly increased, and has rarely sold more readily or at more satisfactory prices than the past year.

Clean cultivation, rather than any special skill or special fertilizer, is indispensable to the best success, as it is hardly possible to grow a profitable crop of strawberries and any considerable crop of weeds on the same ground at the same time.

A strong, well-enriched, moist, though thoroughly drained soil, affords the most favorable conditions. For the general crop the matted row system is usually adopted, and the plants should be set as early in the spring as the ground is in suitable condition to work, and strong plants can be secured. The ground being thoroughly prepared with plough and harrow, the plants should be set in rows from three to four feet apart, depending upon the varieties, and eighteen inches apart in the rows.

To prevent the growth of weeds and keep the soil in the best condition, it will require stirring as often as once in two weeks from the time the plants are set until the middle or last of August. If no other crop is grown upon the ground,

the cultivation the first two months may be largely done with the cultivator or harrow, using the hoe between the plants in the row. As the plants commence making growth they will throw up more or less flower-stalks and would bear some fruit, but as this would be at the expense of the vigor of the plants before they become fairly established, it is better when going over the ground with the hoe to nip out flower-stalks as they appear, giving all the strength to the plants for the after-growth of the runners. When the runners commence to grow, on some of the plants, if allowed to take their own course, they will distribute themselves unequally by growing out upon one side of the plant, but by changing a portion of them to the opposite side, before they commence making roots, the ground will be evenly covered; they will continue to grow and make new plants until late in the season, but they should not be allowed to run together from the rows. A space of one foot should be kept clear in the middle between the rows; this may be done by cutting off the runners or turning them back, if there are any vacant spaces to be filled.

When it is desirable to economize space, as is the case near the larger markets where land is more valuable, a crop of early vegetables may be grown between the rows. Lettuce, early beets, onion sets, and some others, will make their growth and be ready for market before the runners will commence making their growth, and the cultivation of the vegetables will keep the ground clear of weeds; but where this is practiced an extra amount of fertilizer will be required.

A plan often practised by those who grow fruit for exhibition or an extra quality for market or the table, is to set the plants in August, or as soon as strong runners can be secured, in rows two feet apart and one foot apart in the row; they will make strong plants but comparatively few runners, giving a more open exposure to the sun and air, and will produce the finest quality of fruit. The following season these plants will commence throwing out runners earlier than spring-set plants, and if, after the fruit is picked, every other row is taken out and the ground between the remaining rows properly enriched, they will soon make an evenly-

covered matted bed, and after the plants have made their growth the remaining rows of old plants should be taken out, clearing a space one foot in width, leaving the beds of new plants three feet in width. This plan is practised mostly by market gardeners, some of whom set several acres each season upon ground where they have first taken a crop of early vegetables. Grown in this way the ground will be less covered the first season than the matted beds, and will require somewhat later cultivation; but after October first they will require little or no attention until the last of November, when the ground becomes frozen. All the plants, however grown, should be covered with coarse meadow hay, free from seed, at the rate of two tons to the acre; or evergreen boughs if they can be conveniently secured make a still better covering. If the material used is applied while it is snowing the falling snow holds it in place, and it is less liable to be blown off by the wind. No further attention is required except to restore the covering if in any places blown off, until about the twentieth of April, when it should be carefully removed, and if hay is used, a small portion may be left in the paths, as it will prevent the growth of weeds, retain the moisture in the soil, and prevent the fruit from becoming soiled.

The plants will require no further care until the fruit is picked, when, if it is proposed to continue the bed another year, the paths, with the vines on each side, should be ploughed up, leaving a cleared space three feet in width, the ground levelled and well enriched; if the season prove favorable, the runners from the remaining vines will fairly cover the ground. Growers are divided in opinion as to the policy of fruiting beds more than once; the advantages are a saving of time and labor in successive crops. The disadvantages are, that the old beds are more dependent upon favorable seasons to make their growth; the vines are more liable to injury from insect enemies, and rarely produce as much or as good quality of fruit as the first crop.

The selection of varieties will depend upon the object in view by the grower, and the conditions under which the plants are to be grown. No fruit varies so much when separated only by short distances as the strawberry. No variety,

with perhaps the exception of the Wilson, has proved profitable or desirable over a wide extent of territory. The exhibitions rarely show the same varieties as successful prize takers in different localities, and even upon adjoining farms, owing to a difference of location or soil, or both. A variety may prove a success in one case and a failure in the other. Those growing for home consumption would naturally select those of the best quality, though as a rule they are not the most productive; among those of high rank in quality may be named the La Constante, the Wilder, the Hervey Davis and the Jucunda. With the growers for market the tendency has been towards size rather than quality; few buyers know the different varieties even by name, and the consumers in making their selections are governed by the eye, and as the larger fruit is more attractive it sells first and brings the highest price. Among the large growers at the present time in this State the favorite varieties are the Sharpless, the Belmont and the Jewell; these are all of large size, fair quality, and when well grown sell the most readily and bring the highest prices. They are all comparatively late varieties, and the growers are anxiously awaiting the introduction of an early variety that shall equal the above in size and quality.

If but a single variety is grown, one having perfect flowers must be selected. If the pistilate varieties are grown, every fourth or fifth row should be a staminate. The influence of the staminate upon pistilate varieties is now receiving much attention, especially in the Western States, where it is claimed that the influence is not only shown in the seed, but in the size, form, color and flavor of the fruit. If this theory prove correct, the selection of staminate varieties becomes a matter of the first importance.

The strawberry is less liable to injury from disease or insect pests than most of our fruits. A few varieties, among them the Charles Downing, are liable to leaf blight or rust, which makes its appearance before the fruit ripens, and severely injures the crop. The *Melolontha vulgaris*, a large white grub found to some extent in most soils, but more abundant where heavy dressings of stable manure have been applied, requires watching in new beds. He is sluggish in

his movements, but gets there just the same, and makes his presence known by the wilting of the leaves of apparently healthy plants. Examination will show the roots of the plants all eaten off close to the crown. The enemy, having gorged himself, will be found in the immediate vicinity, and may be easily destroyed. Prompt care in their destruction, removal of the dead plants and turning some of the runners from the surrounding plants into the vacant space, will prevent serious damage. A new enemy has recently appeared in some localities in the State, in the form of a small black beetle about one-fourth inch in length. He makes his appearance in the old beds soon after the fruit is picked. In a few days the leaves are thickly perforated, appearing as though riddled with fine shot; he continues devouring the foliage until nothing but the skeleton of the leaf is left and the plants die. He is very shy and quick in his movements, and upon any approach to or disturbance of the leaves, immediately secretes himself in the soil around the crown of the plant.

To the inquiry often made, "What will the strawberry yield?" it may be said that two hundred bushels to the acre is a good crop, though we have well authenticated records of more than twice that amount being grown. One grower in Arlington, the past season, sold from twenty-four thousand feet of land something over one hundred bushels of fruit. This was not a remarkable yield in quantity; but the plants were set in rows five feet apart, and a crop of early beets grown between the rows the first season, and the plants but sparsely covered the ground; but under these conditions what was lacking in quantity was more than made up in quality; the fruit was sold in the Boston market to wholesale dealers and returned the owner over eight hundred dollars.

The currant is a fruit of so easy cultivation, and confined to so few varieties, that there is little that is new or not well understood that can be said of it. The object in introducing it here is, first, because it has not received, and is not at present receiving, from fruit-growers the consideration to which its merits as a market fruit entitle it; and, second, because it can be successfully grown among tree fruits at a

trifling added expense, where no other crop can be profitably produced. Many who feel inclined to engage in the cultivation of the apple and pear are deterred from doing so on account of the time that must necessarily elapse after the setting of the trees before a remunerative crop will be produced. While all the small fruits may be successfully and profitably grown in the early years of the pear and apple orchard, the currant will continue to thrive for many years, and to compete, often successfully, with the larger fruits in its pecuniary returns after the latter pay an income above expense for cultivation and interest on the investment.

One firm engaged in market gardening and fruit growing sold in the Boston market last year eleven tons of currants, grown in a pear orchard where the trees had attained the usual size, and from which a full crop of pears was picked the same season.

Of varieties, the red currant being principally in demand, the Versaillaise or Cherry, generally believed to be one and the same variety, is generally used; but the season of ripening may be extended three or four weeks by setting a portion of the Victoria variety; of this the fruit is smaller than the Versaillaise, but it is a profuse bearer and the most desirable of the late varieties. Of the comparatively small portion of white required, the Dana's Transparent, a native of this State, is generally preferred.

The currant frequently suffers from drought at the most critical time of its growth, just before changing its color. This may be prevented by mulching the ground around the bushes, but the mulch should be removed as soon as the fruit is picked, to prevent the roots being drawn to the surface. There are two methods of pruning the currant, first by cutting back a portion of the new growth, and second, by cutting out every year a portion of the old wood; by the former method the stools become larger and produce a larger quantity of fruit, by the latter the fruit is borne upon young wood and is of superior quality.

The very small additional expense with which the currant may be grown makes it one of the most profitable of the small fruits.

Mr. Edson. The essayist has described the little black beetle exactly as I have it in the cranberry bog. I am surprised to learn that he has got up here among the strawberries. I want to ask the essayist if he knows of any remedy for that fellow.

Mr. Wood. In my first year's experience with him he made his appearance in an old bed, and not on a new bed. During this spring he confined his work entirely to the old bed and left the new one untouched; yet the new one was close up to the old. I put on a heavy application of Paris green, but he seemed to thrive on it, and showed no disposition to relax his hold.

Mr. Edson. I was proposing to try Paris green, but if it does no good I won't try it.

Mr. Wood. Your experience may be different.

Mr. Cruikshanks. My first observation of this beetle was seven years ago. I discovered that the strawberry plants were being injured in the manner described by Mr. Wood. I learned from our friend, Mr. Hadwen, that this beetle was causing a great deal of destruction in the West, and they were ploughing in their strawberry fields to get rid of them. The remedy I applied was to take the plants all out and turn them down, and I had no trouble with it on new plants. It is a fact that none of our small fruits have suffered as much as the currant. The place assigned it seems to be back of some old fence where the grass and weeds try to see which will get possession of the ground first, and the currant bush surely has hard work to get a footing at all. There is no fruit plant that responds so readily to generous cultivation, or that will give better returns for the expense. The history of the currant goes back of three hundred years. It was then presented to the public and was called a smooth-stem gooseberry. Up to 1842 there were only eight varieties. Now you can find nearly a hundred in the catalogue. But the Royal Horticultural Society of London has tested all these varieties, and simmered them down to less than twenty-five in number. Although it was introduced three hundred years ago, it was not until the beginning of the present century that the currant became a standard fruit in the garden. But it has been cultivated in a small way. It is one

of the most healthful and refreshing fruits, and can be used for so many purposes that it is a mystery why this fruit has not been much more generally cultivated.

One cause of the success of the Victoria as a keeper is that the foliage stays on the plant, and thereby the fruit is preserved. I have kept the Victoria until September, when the Cherry had gone by several weeks before. It should be grown on a deep, rich, heavy soil, in order to get the best results. If it is grown on a light soil it must be mulched, or before the fruit is thoroughly ripe the foliage will fall, and then the fruit will go also. I have read of parties that have cleared over five hundred dollars on a single acre of currants; and they can be grown, as has been remarked by the essayist, between pear trees. They must have cultivation. If the grass is allowed to run into them they will get choked up. They will continue to bear, but the fruit will be of an inferior quality. Plant the bushes where you can take care of them. But the result will always be satisfactory, if they are given good care and cultivation.

Question. Have you had any experience with Fay's Prolific?

Mr. Wood. I think the Prolific has been one of the best advertised fruits, and I think there has been more fraud and deception in its sale than any other. I believe the Fay currant, if you get it, is so near the Versaillaise that no man can tell them apart. A half a dozen other varieties have been put on the market and sold as Fay's, and there is a great deal of prejudice against them on that account.

Mr. Stetson. I would like to inquire the remedy for the insect that cuts off the stalk.

Mr. Wood. I have never had trouble that amounted to anything. They cut off a part of the new growth, — the heading-in of the new growth, which is needed.

Mr. Stetson. I have quite serious difficulty. I only raise a few. The insects eat off the wood so that in the spring of the year I can frequently pull the old stalk entirely over.

Mr. Wood. That is on the growth of the previous year?

Mr. Stetson. Yes, sir. I thought I would like to know if there is any remedy.

Mr. Wood. I do not know of any.*

Mr. Kinney of Worcester. I would like to ask Mr. Wood if he knows anything about the Jucunda strawberry; whether he knows of any place where it is holding its own; and whether the work of this beetle that is commonly called the strawberry beetle, is not the reason why beds are not cultivated two years, as used to be the practice?

Mr. Wood. The beds are run very generally in our vicinity in the eastern part of the State the second year, and in the vicinity of Boston I have heard nothing of this beetle until this year. Some growers in other parts of the State have been troubled with it, but I do not know that it has deterred any one in our vicinity from growing their beds the second year. Before we had any difficulty with that beetle, it was a question with many who grow on high-priced land. In Belmont and Arlington they have for years grown but a single crop from the vines. They grow three crops in two years. They set out their vines with the rows wider apart than I recommended in the essay, five feet apart, and sow early beets between. They get a paying crop of early beets, and then their strawberries run over the ground for the remaining part of the season, and next year they pick their crop; and as soon as the crop is taken off they clear the ground and set it out to celery, and so grow three crops in two years.

As to the Jucunda, it is like a great many varieties, diminished year by year. You will remember the Triomphe de Gand was a popular variety, but it cannot be found in our vicinity; but the Jucunda has retained its position. I met Mr. Kinney from Worcester — the gentleman's father, I believe, who is one of the largest fruit growers from that city — last year, and he informed me the Jucunda was among the most profitable varieties.

* Mrs. Mary Treat, in her book entitled "Injurious Insects of the Farm and Garden," page 206, has the following: "The Currant Stalk-Borer (*Ægeria tipuliformis, Linn.*). — This is an imported insect and of the same genus as the peach-borer. The moth lays her eggs singly near the buds, and the larvæ, when hatched, make their way directly to the pith, which they devour, forming a channel several inches in length. The stem, thus weakened, shows by the inferior size of its fruit that this insect is present, and it often breaks off at the affected part. The impoverished growth of the stems indicates the presence of this borer, and at the fall pruning all such should be cut away and burned."

Mr. Kinney. In our experience, now the bottom has dropped out of it. It has been for years the nicest we had, and there was no fruit that compared with it for firmness; but it is gone, and I should like to find out whether it is so throughout the country.

Mr. Wood. Well, we have had it exhibited on the tables of the Massachusetts Horticultural Society every year, but not as much as formerly. It is an excellent berry.

Question. Does not ploughing up a strip about three feet wide between the old rows of strawberries, and letting them cover it over with new runners, make substantially a new bed? Do you plough up the old and make a new row where the old was?

Mr. Wood. Yes, sir; but I said, cultivated in that way we were more dependent upon a favorable season. That is, the runners do not run as readily from an old bed that has fruited as from a bed that is set out in the spring; but if the ground is kept in good condition, you will get a very fair bed in that way.

Mr. Augur. Do you know, sir, about what date this beetle you speak of appeared?

Mr. Wood. I should think the first I saw of him was the very last of July or the first of August. I will say here that Mr. Saunders, in his book on "Insects Injurious to Fruits," says that they appear before the fruit is ripe; but they have not on our beds, so far as I know, appeared until the fruit is picked, the last of July or the first of August. May I ask the audience if any other person here has noticed it upon his strawberry beds?

A Voice. I have, for one.

Mr. Kinney. I think it very strange that there are not more people here acquainted with it, for I feel very certain the same fall Mr. Cruikshanks discovered it, it was discovered with us. We are located in Worcester city. It has in fact entirely ruined all those beds. I am not a scientist, and do not know about the growth of the insect particularly, only I feel confident that the damage is done before the beetle appears. The larvæ grow in the stems. They affect the small stem plants but very slightly, there is not sufficient room for them to grow; but take it on the Jewell and Sharpless, the

larvæ, which resemble the cabbage maggot, do their worst work. They strike the bed very soon after picking the second crop. We have two crops in the year. They often ruin the leaves before they start to grow in the spring. But they seldom amount to very much, because they eat up a few leaves at first and stop, and nothing more is seen of them. During picking time on an old bed you will see great spots where the plants go down without any reason. Well, that same bed as soon as the picking is fairly done will be literally covered with these little black insects, and I have found no way of doing anything with them, except to turn the bed under. For the larvæ to grow to any extent, they must have a plant of sufficient maturity to breed in.

Mr. Augur. This is a matter I do not know anything about personally, but this fact of its making its appearance at the starting of the leaves leads me to think that there is a chance to apply insecticide in a liquid form, either hellebore or Paris green, and it will prevent the appearance of the second crop. If you can get rid of them in that way early, before there is any danger of injuring the fruit, I think it is possible that might be done.

I would like to say just a word in regard to the currant. I have been greatly interested in this excellent paper which has been given. It is full of suggestions; but I want to say a word in behalf of the Fay currant. I think it is really a very desirable variety, and there is a difference, I think, between it and the Cherry. It has a longer stem from the stalk. The stem before you get to the fruit is longer, it is easier to pick. Pickers like to pick the Fay currant better than the Cherry currant, and it suffers less damage in picking. I think the true Fay currant is to be the market currant when once it is well understood.

There is this point about planting the currant, and I think it is worth considering. There is more danger of overstocking the market with currants than with strawberries. We can easier place ten bushels of strawberries than we can one of currants. I would not advise any one to plant white currants for the market. There is nothing against the white currant except its color, but it does not sell. It goes off very slowly. We have threatened again and again to take

out all our white currants. In regard to the Victoria, our experience has been that any late ripening currant does not sell well. There is a large call, perhaps more than for any other one purpose, for jelly making. There are persons who buy it in large quantities, and it is well known that the currant should be picked early to make good jelly. After it gets very ripe on the bushes it does not jell well, and the Victoria, when it is late for good jelly, does not sell well. The people are afraid of currants after about such a date, and the prices of late currants are invariably less than those of early ones.

Mr. Cruikshanks. When I discovered the little strawberry beetle, I told Mr. Kinney's father what trouble I was having. "Why," said he, "we have none of it;" and he went home and found his fields full of it.

Adjourned to one o'clock, P.M.

Afternoon Session.

The meeting was called to order by the Chairman at the appointed time, and Mr. A. H. Smith, an enterprising and successful young market gardener of West Springfield, was introduced as the first lecturer of the afternoon.

MARKET GARDENING.

BY A. H. SMITH OF WEST SPRINGFIELD.

"The battle is not to the strong alone, it is to the vigilant, the active, the brave." Equally true is this of market gardening, for success in this occupation is dependent, more than in many others, on the rounded development of the man.

A high sense of honor should govern one in treatment of help and in marketing of products. Energy and perseverance should so direct him that he may be undaunted even in the face of unfavorable seasons and unprofitable crops. A liking for his work must be joined to the inclination and ability to study crops in their relations to fertilizers, soils and markets.

To me has been assigned the task of outlining some of the problems of market gardening. I do so under these

divisions: 1. Location and Soil of Market Garden. 2. Manures. 3. Seeds. 4. Seed Sowing and Crop Culture. 5. Markets and Marketing. 6. How we raise Special Crops.

Location and Soil of Market Garden.

For an ideal market garden we choose one having a variety of soils and a varied exposure. For our early crops we seek a southern aspect, protected on the north and north-west by bluffs, buildings, trees or at least close fences. We prefer for most vegetables a lightish loam having a little sand in its composition, and for these reasons: We can work land of this description earlier in the spring, and if, perchance, worked when too moist, it partly or wholly recovers from the ill effects. It responds very quickly to high manuring, and is well adapted to the cultivation of small crops by improved garden tools. In soils of this kind we find the conditions necessary for rapid root development, and necessarily, therefore, of vigorous plant growth.

Manures.

Having our parcel of ground adapted to gardening, we are confronted by the omnipresent fertilizer question. Some one has said, "To develop the utmost economic capacity of a given soil by fertilizing appliances, is the work of a wiser man than belongs to our day." Growing plants require food; accordingly, before we can crop land heavily we must fertilize abundantly. The chemical elements entering into the composition of plants are comparatively few, and the ash or mineral elements very light.

It is estimated that an acre of grain contains but one hundred and forty pounds of ash elements, while the weight of the foot of soil on the surface of the grain field may be nearly four millions of pounds. The question continually reverts: In how concentrated a form ought we to give the fertilizing elements to the plants? Some reason that, as it would be folly to try to satisfy a hungry horse with a few whiffs of hydrogen, oxygen and nitrogen, seasoned with chlorine or fluorine and an occasional pinch of calcium, sodium and phosphorus, so it would be equally unwise to feed plants

with their chemical constituents merely. I will not take time to develop the analogy, as I firmly believe that for many market crops the bulky stable manures are the more efficient, and therefore the cheaper fertilizers. I give as reasons: 1. Experiments prove that stable manures furnish the proper elements of plant food; and, 2. In a manner and proportion suited to plant growth. 3. In their decomposition they render available to the plants some of the latent plant food of the soil. 4. The mechanical condition of the soil is much improved by their use. 5. Sun and air far more readily give their aid to the growing crop.

In short, an abundance of manure will often make a soil that is cold and unresponsive a very choice one for slowly maturing crops. I am not ignorant of the wheat experiments of Lawes and Gilbert, but I am yet to be convinced that as generous and profitable crops of cauliflower, celery or lettuce, could be raised year after year by the use of chemicals as by the application of barnyard manures.

To be sure, at fairs we sometimes see a placard to the effect that the exhibit was raised by using a certain brand of fertilizer. A few well-directed questions will often, if not always, bring from the exhibitor the admission that the land was well manured for its crops the previous year.

We have in tillage and grass about thirty acres. On this tract we use yearly, besides the manure made on the place, six or eight tons of commercial fertilizer, some lime and ashes, and the manure of about one hundred horses kept in city stables. As we do not mean to top-dress our grass land, excepting door-yards, we seed down each fall two or three acres, and have an equal amount of turf land to break up. From the six or eight acres in grass we cut hay for five horses, five cows, and have a little to sell. We raise also a little yellow corn, but with most of our fertilizers we raise market crops, whose proceeds pay the help, meet interest and taxes, buy seeds and implements, provide the fertilizers, and make the permanent improvements on our gardens.

Seeds.

Where shall we procure them? We are commonly advised to raise them. The papers are fond of telling us that if we

will only save a few of the best specimens of our vegetables for seed, and then set them out, we shall get seed superior to what we can buy at any price.

The advice ought to be given in this form: Select for seed-stock the choicest specimens which are true to type, of solid texture, of fair size and colored alike. Preserve them in good condition till set out in land suited to the especial crop. If the season is favorable we shall get our seed, but at the cost of so much time and patience that it is doubtful (unless we are to make seed-raising a specialty) whether we could not better afford to buy pedigree seed at a fancy price. I think an illustration will make clear what I mean.

All of us would describe a typical carrot as one having a thick, symmetrical root rather than a slim or tapering one. I have here several carrots chosen with that definition in mind.

The first might represent the Guerande carrot.

The second might represent the Danvers carrot.

The third might represent the Intermediate carrot.

The fourth might represent the Improved Orange carrot.

The fifth might represent the Long Orange carrot.

Though these specimens probably came from a single package of seed, and though each might to a degree be typical of a class of carrots, yet they are not all of equal value for seed purposes.

Those of medium length best represent the average specimens of the crop, and so from them we should work to most advantage in establishing our strain of seed.

It is a work of equal difficulty to select specimen beets, parsnips, onions and turnips; even more the choice of cabbages and lettuce; while the raising of cauliflower and celery seed is generally left to experts.

At the recent Bay State Fair I heard a gentleman remark that a strain of turnip seed that would invariably produce specimens like some on exhibition would be worth five dollars a pound, and I could well believe it would.

I have here a few specimens of onions which were prize-takers at that fair, and show what judges consider good points in onions.

Our rule about procuring seed resolves itself thus: Buy

the best seed you can get. Along the line of your specialty seek to originate, or at least improve on the best strains in cultivation. Remember that "trifles make perfection, while perfection is no trifle!"

Seed Sowing and Crop Culture.

The condition of soil best suited to the germination of small seeds is one finely pulverized; not moist enough to be sticky, nor yet dry enough to be dusty. After covering the seed with earth to the depth of about four times the diameter of the seed, the land should be firmed or rolled.

Where laborers are scarce, hand work can be saved by omitting to sow every third row of root crops. In the broad spaces the horse cultivator may be used. If the plants are left a little thicker in the rows than when every row is planted, a full crop may be expected. I have even seen onions so planted which did well.

When the seed germinates begin the use of hand hoes or cultivators. The smaller the plants the more vigorous must be the efforts to keep the crop free from weeds.

Defer haying, neglect corn and potatoes if you must, but keep your garden patch clean at all costs! As your crops mature, harvest them.

In rotation of crops all of us should make experiments, as differences of manuring and culture call for different methods of rotation. Our rule is to get as many crops as possible from a given tract in a given time; and, ordinarily, by following crops having abundant foliage with those having special root development, or the reverse.

Markets and Marketing.

For a limited amount of produce (novelties and extravagances aside), the smaller markets average larger prices than the cities; simply because there is less competition. Whatever your market demands, raise if possible. When raised, trim and pack neatly; for slovenly arranged produce often goes begging for customers. It is a decided advantage to have boxes and crates of one style, well made and plainly stenciled, so that consumers may know your packages in the markets. In packing discard imperfect specimens, re-

membering that the more even the contents of the package in size, shape and color, the sooner we shall find a buyer and the larger will be the margin of profit. If one raises only so much as he can sell to consumers without the aid of middle-men, not only does he average higher prices, but in years of abundant harvests he will be more sure of customers and a fair income. In selling to market-men we ought not to crowd the market. Better feed a little green stuff to your cows or pigs than overstock it. One shrewd strawberry grower follows this plan: If the market-men refuse to give him a fair price for his berries, he takes them home and on the morrow takes them back, satisfied to receive the price refused the day before. As the berries are now no longer strictly fresh, the market is not hurt for fresh-picked berries.

This is but one device. The thing we urge is, that as producers we deserve fair prices for our commodities, and ought not to take whatever any one may see fit to offer us.

As a rule, don't hold crops for high prices. The country is large, freight is cheap, green stuff is perishable, and then it is only the nimble pence that make quick shillings.

The Crops we raise.

We raise three or four acres each of potatoes, sweet corn and cabbage, with the ordinary vegetable crops in varying amounts, and make a specialty of winter root crops.

In our hot-beds we grow lettuce and vegetable plants, in our cellars we store cabbage and roots, so that we can wait on our customers all the year round. In mid-winter we start our hot-beds. When spring opens we spread fertilizer on land well manured in the fall and sow our onion seed. Then prepare land for peas; soon sow spinach and beets; then plant potatoes, and spade or plough rhubarb and asparagus beds. Cabbage and lettuce plants, also onion sets, must be put out, manure piles must be forked over and seeds made ready for later crops. In short, from one year's end to another we mean to have enough to do.

How we raise our crops would be too long a story to tell, but we may give a brief outline, and describe in detail a few which are often shipped to considerable distances.

Sweet corn is raised much as field corn is grown. On

most land it may be grown by the use of commercial fertilizers entirely; the seed should be selected with care, as it deteriorates readily by mixing, and cures so slowly and imperfectly that it does not always germinate well.

About potatoes and roots as market crops, I will only say that the smoothest and finest are invariably raised by application of well-rotted manure or special fertilizer.

Our onion beds are heavily dressed with manure in the fall, and receive a top-dressing of ashes or chemicals in the spring. After thoroughly pulverizing the land the seed is sown and the bed rolled. Clean culture follows. Danvers is the variety we mostly raise, allowing from four to six pounds of seed per acre. From four hundred to six hundred bushels per acre is a common yield, though some growers claim much larger amounts.

We raise strawberries in limited amount, chiefly of the Crescent, Green Prolific and Sharpless varieties. They have sold well the past season, and one large grower prophesies a boom all along the line of small fruits. We set our plants on land well fertilized for other crops, sometimes setting before the crop is removed.

For our cabbage crop we seek land not used for cabbage for several seasons, and manure as generously as for tobacco. For the main crop we set about July first, or at any rate early in that month, in rows three feet apart, with the plants from twenty-seven to thirty-six inches in the row. At the former distance about sixty-five hundred can be grown on an acre, while at the latter only about five thousand.

If not sold in the fall we store them in cellars and pits for a winter market, usually, however, suffering some loss from decay.

Celery, lettuce, cauliflower, and kindred crops must be well grown to command good prices; for, unless of good quality, they can scarcely be sold at any price.

In conclusion, one sentence. A market gardener's success depends on his ability to supply the market's demands for the choicest varieties of vegetables in the neatest packages; requiring in their production, of course, suitable soil and abundant fertility, added to intelligent and persevering labor.

Mr. Stratter. How can a man keep his cabbage crop the year round?

Mr. Smith. We do not keep our crop the year round, but we keep it until the Southern cabbages are on the market, until it is no use to have it any longer.

Mr. Ely. Have you any trouble with club-footed cabbages, and if so, what do you do with them?

Mr. Smith. We have had no trouble with club-footed cabbages for fifteen years. The remedy, I suppose, is in the selection of the land, as I gave it in the essay, choosing land that had not been used for cabbages for several years. You will find in some fields low spots where the water stands. Cabbages in these spots will have more of a tendency to club-foot than they will on the ordinary field. I do not know as I have any explanation of it, but other growers tell me it is so, but in our own experience we do not have it.

Question. Have you ever had trouble from the cabbage worm, — the green worm?

Mr. Smith. That does not trouble a great deal where cabbages are raised in large quantities. In small quantities they do trouble somewhat. There are about so many green worms to the acre, and if they are distributed among ten thousand heads, they do not do any particular damage. The enemy of the cabbage we have to contend with is the maggot on the early cabbage.

Mr. Sage. I would like to ask the speaker if a wet season has anything to do with the keeping qualities of cabbage?

Mr. Smith. Well, we make the effort to keep ten thousand heads. I have ten thousand sound cabbages now. We shall try to keep them, and next spring will tell better how they have kept. I have some stored in three ways this winter. What we store for immediate sale we can store almost any way. What I expect to sell last are in racks; and some I have piled up, the roots together and heads out, in beds right across the cellar that rise as high as a person can conveniently put the cabbage on.

Mr. Sage. To keep them, do you cut the roots off or leave the roots on?

Mr. Smith. I cut the roots off of those on the shelves, because it takes so much room with the roots on; but the others I do not take off.

QUESTION. Are the samples in the room below a fair sample?

MR. SMITH. They are smaller. I put them there to show the quality. That is what is wanted in judging of vegetables.

QUESTION. Are they all as dry and hard as those?

MR. SMITH. Well, of course those are exhibition specimens, but I think the flat Danvers are as hard as those, but not the round ones. Those are pretty good specimens of the round ones. The flat Danvers are generally a little earlier.

MR. ——. The gentleman has admitted he had trouble with the white maggot, but he does not tell us whether he has any means of fighting it. If he has, I wish he would tell us.

MR. SMITH. Well, I do not know that there is any remedy for it. This year we have not been troubled with it. Two years previous to this year we were. I have taken more pains in raising my cabbage plants. I do not claim that taking care has had anything to do with it, but I have had better luck.

QUESTION. What do you do for the onion maggot?

MR. SMITH. I have not had any trouble since I have raised onions, but I have seen various things recommended.

MR. SAGE. A friend with whom I was conversing recently has lost perhaps several thousand heads of his cabbages, and he could assign no reason except the wet weather. The roots were six inches under ground, and were cut off within an inch of the head, and they were all rotten. What was the cause?

MR. SMITH. I think they were planted too soon, and were too ripe. Wet weather produces a different growth than a dry season, it produces a different flavor; but at this time of year there ought not to have been any trouble with wet weather.

MR. SAGE. Was this loss due to cutting off of the roots?

MR. SMITH. I do not think it was.

MR. SAGE. Was it due to covering deeply?

MR. SMITH. It may have been. I do not know. It may be because they were covered with dirt directly.

MR. SAGE. No. They were placed one layer of cabbages

on the surface, and I think a spreading of hay before the soil was thrown upon them.

Mr. Smith. I never heard of any cabbages rotting so early in the year unless they were very ripe.

Mr. Sage. Does a superabundance of water create a superabundance of water in the cabbage head when the season is dry?

Mr. Smith. I do not know about that.

Mr. Sage. I would like to ask the gentleman what celery he finds the most satisfactory and profitable?

Mr. Smith. I think my heaviest heads. That is a little different from the question he asks. My heaviest heads would be most profitable for the market, but of course it is more work to trim them. I like to see celery, of which thirty-six heads would sell for a box. I know there are many here in the hall that differ from that, but I should think the Boston market now is for celery of that class. White Plume I have not raised extensively this year. I have in other years somewhat. This year I raised some Golden Heart that was very good. That is very nearly as easily planted as the White Plume. For many uses I like it better.

Question. I would like to ask the gentleman if he considers any celery that is not banked fit to eat?

Mr. Smith. Well, I think the gentleman that raised White Plume celery told us that it could be planted very much quicker than the other, and I should think perhaps half of it would be fit to eat. But if I was going to raise it, I think I would follow a different plan from what I did when I raised the White Plume before. I should raise it for an earlier market.

Question. Does not the gentleman find, with the White Plume or any other celery, that, if it is not banked, it has not a satisfactory market?

Mr. Smith. Well, I did not suppose celery was ever put into the market that had never been handled, as you say, paper put about it; I suppose that is always done. There are people in the hall who raise early White Plume without any earth.

Professor Humphrey of the State Experiment Station.

Is there some one here who will volunteer to send to the Experiment Station at Amherst some good specimens of club-footed cabbages and turnips? I do not want a large specimen, because it is for microscopic study, and will take but a little piece. If any one here will volunteer to send me such a sample at Amherst, I will be very greatly obliged.

The CHAIRMAN. Our next lecture is upon Irrigation, by a gentleman who not only practices it extensively upon market garden crops, but has the past season journeyed across the continent to observe the workings of the systems of irrigation in Colorado and California. He is abundantly able to interest the audience: W. W. Rawson of Arlington.

IRRIGATION.

BY W. W. RAWSON OF ARLINGTON.

In the growing of crops of all kinds, there are many things necessary for their development. Some of the principal ones are air, light, heat and moisture. No one of these is of more importance and more necessary to their development than moisture.

From seventy-five to ninety-five per cent of the composition of vegetables is moisture. Of fruits, seventy to eighty-five per cent; of grasses, seventy to eighty per cent. To grow these to perfection, more moisture is necessary than furnished by rains and the atmosphere. The supplying of moisture by artificial means is called irrigation, which is one of the means used for producing fertility in the soil.

It was first used in Egypt nearly four thousand years ago, and has since been used in all countries. The Romans took the lead at the beginning of the present century. The pools which Solomon constructed were to hold water, which was to be used for irrigating the soil. In Ecclesiastes, the second chapter, the fourth, fifth and sixth verses, we read: "I made me great works; I builded me houses; I planted me vineyards: I made me gardens and orchards, and I planted trees in them of all *kind of* fruits: I made me pools of water, to water therewith the wood that bringeth forth trees." From then to the present time nearly all nations have had more or less use for irrigation.

The method of using irrigation differs very much in different countries. Very much depends upon the locality.

Where there are but two seasons, the wet and dry, they can tell very readily when to prepare for irrigation; but where there are four seasons, it cannot be known until the dry season arrives, which in our New England States generally occurs in the summer or in our hottest weather. Sometimes in the fall, in order to perfect a crop of celery or cabbage or cauliflower.

Very many of our vegetables are grown under glass, so that with us irrigation becomes a necessity.

The better facilities one has, the less the expense, and the more perfect will be the success in securing the crop.

When the grower understands irrigation, it is much easier to get a good crop under glass than it is in the field, and I had much rather undertake it.

The subject of irrigation must be well understood, if it is to be used so as to secure the best results in growing a crop.

It is very evident that no crop can be grown without it.

There are various methods of applying moisture to the soil and to growing plants, such as running it over the surface in furrows or trenches, playing it upon the foliage, and by filling tiles, which is mostly practiced on low lands by stopping the lowest end of the tiles and filling them from the lowest point. This method I would recommend for low and heavy lands, because if applied to the surface the soil will harden and become an injury to the growing crop. On sandy lands the most benefit can be derived by running it over the surface about once a week, and applying about one inch at a time, which is about the average rainfall of our New England climate.

When the rainfall is uniform no irrigation is necessary; but as it is too often the case, no rain falls for two or three weeks or more, then it becomes necessary to make two or three applications.

Irrigation by watering the foliage is not recommended, except under glass, when it is often necessary and can be applied without injury to the growing crop.

It is better to water under glass on a pleasant day than on a

stormy or a cloudy one; but in the field a cloudy one would be preferred if the water was to be applied to the foliage.

The supply for irrigation is taken from ponds, rivers, brooks, or it is pumped from driven wells. I much prefer to pump from wells in all cases, because in the summer the water from ponds or rivers is quite warm, while that from wells is cool, which will be an advantage to the crop, especially if the ground is dry and hot, as is often the case; and in winter if taken from ponds or rivers it is very cold and could not be put upon the plants until it had been warmed, while that taken from wells would be at a proper temperature to be applied immediately.

For these reasons I have always preferred the wells and have always used them.

The appliances used for pumping are the wind-mill and the steam pump; but it is much the best to have both.

The cheapest pumping is done by the wind-mill, but when it does not pump a sufficient quantity then the steam pump can be used.

In many places there are elevated ponds or rivers that can be taken from. When such is the case no pumping is necessary.

There are some very extensive works of this kind in California and Colorado. I visited one this last summer. It had nine hundred miles of canal. I saw it about forty miles from the head. At that place it was twenty feet wide and ten feet deep. The land sloped about ten feet to the mile and the water flowed about two miles an hour. There were many small canals or ditches leading from the large one. This entire system would irrigate about sixty thousand acres of land. It was a very great undertaking to build it; but it increased the value of the land very much, so that when it was sold it brought five dollars more per acre.

In addition to this increase in the value of the land, every one who used the water paid so much for the use of it.

The past year the cost was sixty-seven cents per acre, so you see the cost of irrigation was quite small.

It was mostly used for vineyards, and was applied when the crop was growing. When the crop was nearly grown its use was stopped, and none was applied while the crop was ripening.

The weather there is very even, so that they know just what to depend upon. So even is it that they dry all of their raisin crop in the field without any fear of rain.

There are other plans of irrigation carried on in that section which are not so extensive. Most of the vegetable gardeners use wind-mills, some of them having as many as five or six on their place.

Others use steam pumps. Their land is all arranged for irrigation. They pump the water into a large tank and conduct it through their fields in wooden troughs made for the purpose.

They are about ten inches square, and are so constructed that the water may be let out at any given point. They allow it to run over the land, and use as much as may be required.

We do not irrigate in the same manner, nor can we. They know there will be no rain for a given time. We do not know from one day to another, and are in constant fear lest the shower that comes to-day may be the last for a month. We have to put the water on lightly, for fear there may be a deluge the next day. One inch of water at any time is all that it is safe to apply. If there is no rain for a week then another inch, and so on through the season, as the necessity may demand. I think one inch of water over the surface once a week will keep any crop growing in the dryest weather.

A good steam pump will supply that amount through a three-inch pipe in six hours — twenty-five thousand gallons. I mean by a "good pump," one that will pump one hundred gallons per minute. I do not recommend a smaller pump, because it will cost just as much to run one half the size; the only difference being that a little smaller quantity of coal will be used The cost of a large mill is not much more than a small one, and it will do many times the work of a small one with the same labor. I would as soon think of being without a steam pump as the farmer who cuts hay would of being without a mowing-machine.

It takes one man to run the pump and one to attend the hose. But very little hose is required if the land is well piped. I would recommend piping the land with two and

one-half inch cement-lined pipe placed in the ground, with hydrants but a short distance apart; that is, one line running from the mill or pump, as the case may be, to each of the buildings and hot-beds, and then pipe for the remainder on top of the ground, with three-inch pipe, so that the ground will be well covered with pipe enough, and then very little hose will be required. The pipe on top of the ground must be taken up in the fall and put down in the spring. All of the pipes must be connected with the pump and wind-mill if both are on the place.

This may seem very expensive to some, but it will save much time in the busy season by having the water carried to all parts of the place. Upon a place of ten acres the expense of furnishing pump, boiler, pipes and fittings would not be over one thousand dollars.

I had rather have a place of ten acres well fitted for irrigation than one of twenty acres without irrigation; and I venture the assertion that I could raise more vegetables, or receive more money for my crops in a period of ten years from the ten acres irrigated than from the twenty acres not irrigated.

The question of irrigation is not difficult to understand. One simply needs to know the rules of nature and to follow them, and then it is very easy.

An animal will not thrive though he may have plenty to eat, if he has nothing to drink. Just so with plants; but plants require more water according to their bulk than does an animal.

If the usual fall of rain, which is one inch, would be sufficient to grow any crop, then the same quantity supplied by irrigation should be sufficient; and if the greater part of a growing crop is moisture, then it is very evident that it must be supplied, and if not by nature, then it must be by artificial means which we call irrigation. Many may say, I have no water. To you I would reply, there is not a farm of twenty acres in New England but has water enough upon it, or running through it or under it, to irrigate it. This is a very broad statement, but it has proved itself true.

Any farm that is well arranged for irrigation, whether it be of five, ten or twenty acres, will bring enough more at any

time when offered for sale to pay for the amount expended. Therefore the expense would be only the interest on the money invested, besides the fuel and labor. We will allow $50.00 for interest, or $2.50 per acre for twenty acres. The cost of running a pump for twenty-four hours would be: for coal $3.00, for labor $7.00 (if run day and night), additional help in moving hose, etc., $1.00; making a total of $11.00 per day to irrigate four acres, or $2.75 per acre if only one application was made, and a total cost of $5.25 per acre if only one application was made. If two applications were made, $4.00 per acre; if three applications were made, $3.63 per acre; if four applications, $3.38 per acre.

Is there any crop grown that will not allow of this outlay upon it? If there is, then certainly there can be no profit in growing it, and we had better turn our attention to something else.

I have seen, with three applications of water, a crop that would not have brought $200 per acre, bring $1,000, and it was all done in three weeks' time.

I have seen others nearly doubled by one application, made at the right time and in the right way.

In closing I would say, arrange your land for irrigation; obtain the necessary equipment; plant your crop for irrigation, and plant those best adapted to soil and locality; study the subject and understand the requirements of your crop, and you will find that there will be no department of your farm or market garden that will be of so much benefit to you, or that will so well pay you for the investment, or upon which you will place so much confidence to insure you a good crop in any season, as your well-arranged system of irrigation.

Moisture in Garden Crops.

	Per cent.		Per cent.
Artichoke,	81.1	Cauliflower,	90.4
Asparagus (shoots),	93.3	Celery,	84.1
Beans (broad),	14.3	Corn (stem and leaves),	86.9
Beans (kidney),	13 6	Cucumbers,	95.6
Beets,	88.0	Kohl-rabi,	89.4
Beets (sugar),	81.5	Lettuce,	94.0
Cabbage,	90.0	Mushrooms,	88.8
Cabbage (red),	90.1	Onions,	86.0
Carrots,	87.5	Parsnips,	88.3

Moisture in Garden Crops — Concluded.

	Per cent.		Per cent.
Peas (green),	79.5	Radishes,	93 3
Pumpkins,	89.1	Spinach,	88.5
Potatoes,	75.0	Squash,	90.0
Rhubarb (stems and leaves),	91.7	Turnips,	92.0
Rhubarb (root),	74.4	Horse-radish,	76.7

Moisture in Fruits and Berries.

	Per cent.		Per cent.
Apples,	83.6	Raspberries,	86.2
Pears,	83.0	Blackberries,	86.4
Plums,	81.2	Mulberries,	84.7
Peaches,	88.7	Gooseberries,	85.7
Apricots,	81.2	Currants,	86.0
Cherries,	80.3	Blueberries,	82.7
Grapes,	78.2	Cranberries,	89.6
Strawberries,	87.7		

Moisture in Grasses, Clovers, etc.

	Per cent.		Per cent.
Timothy,	70.0	White clover,	80.5
Orchard grass,	70.0	Green oats,	81.0
Red clover (in bloom),	80.0	Serradella,	80.0

Mr. Washburn. I should like to inquire whether it will do at all times to take water from an ordinary well and apply it to growing crops, and if the temperature is not too cold at certain seasons of the year for the application?

Mr. Rawson. I would say that at no time of the year have I found well water that was pumped from twenty or thirty feet below the surface that had not a temperature as high as fifty, and I know of no crop grown that will not stand a temperature of fifty degrees. Cucumbers are the tenderest, and they will stand water at fifty degrees at any time. I have tried the temperature a great many times, and have never found it below fifty, and therefore recommend pumping from wells instead of from rivers and ponds.

Question. In that case water can be applied to surface drains. How deep can those drains be laid, if deep enough to escape the plough?

Mr. Rawson. You wish to ask about filling the tiles?

Mr. ——. Yes, sir.

Mr. Rawson. It is according to the quality of your land,

and the depth you run your plough. Now, in our sandy soil we should have to put the drains certainly a foot and a half, because we plough nearly fifteen inches; but in many soils, where you plough only six or eight inches, ten or twelve inches would be sufficient distance, and the tiles to irrigate the land should be laid about ten feet apart. I irrigate my celery, which is in rows of six feet, by ploughing a furrow for each row. Now that will wet the land three feet each side very well. The farther apart you put your tiles, the more water they will require to irrigate the land between.

Question. Do you use the common drain tile?

Mr. Rawson. Yes, I should if I used any, so that the moisture would come through the joints.

Mr. Smith. I suppose that the water in the ordinary drain tile would go to the lower end of that quite rapidly, and escape there through the land at the lower end before you could get any to stand in your tile near the upper portion of your field to be absorbed by the soil, would it not?

Mr. Rawson. Yes, sir; but it is not always necessary to run it down the steepest way. You could run it across, make a slight decline of the tile. An incline of a few feet would be sufficient to make a tile at the end take down the water. You would need it at the end to take it off.

Mr. Smith. Would you drain the land at all?

Mr. Rawson. It would drain it if there was pitch enough. Tiles six or eight feet apart would drain almost any land, with outlets at the end to take the water off.

Question. I understand you irrigate by the surface, and not by the tile?

Mr. Rawson. Yes, sir.

Question. How do you apply it?

Mr. Rawson. I apply it in furrows. I plant my cabbages in rows, and fill the furrows between them with water once in so often, and the same with my celery and beets. I arrange my land for irrigation.

Question. Why would you need any tiles at all? Why would not the furrow be better?

Mr. Rawson. It is according to what your subsoil is. If the subsoil is clay, it would be necessary to have some tile. If the subsoil is gravel, I do not think you would need any

tile, because the water would go right through. For that reason I would not recommend applying more than one inch of water at a time, because you would lose a great deal of water.

QUESTION. Suppose you had a place forty rods long, in how many places would you apply the water in that forty rods?

MR. RAWSON. Well, it would depend upon the decline of the land. If the land was very level, I should apply it in two or three places; but if the land had quite a decline to it, one place would be enough. I have a place where one of my fields is something like between four hundred and five hundred feet. The decline is, I think, about five feet. I can run a stream the length of that in one minute, but you have to have the stream, you have to have the water. You want two two-and-a-half inch streams, and make a regular brook of it. If you have only a little water, it will soak in about as fast as you pump it on. I do not recommend anything of that kind. I have a lot of steam fire-engine hose, that is very easy to be obtained, which I connect with my three-inch pipe, and then when the pump is running, I run it into both furrows, and the water will soon go to the other end, and the ground along the way will take what water it requires, especially if a new furrow has been ploughed recently. I would have the man at the upper end change the hose before it got to the lower end. Those things have to be looked after. There is no necessity of wasting any water. A man can learn by practice just how far down that row the water will be when it is necessary to take it up at the upper end. If he does not know enough for that, I would put on another man.

MR. SAGE. Are there many men in Massachusetts who have farms that they can arrange on the hill-side, where they can catch water? Would it not be more desirable to catch it, and lay up a store of water for drought?

MR. RAWSON. Yes, sir; if that can be done. Any way you can store up water and get it at the least expense is the way to do it.

MR. SAGE. How large should a reservoir be for five acres?

MR. RAWSON. You would want one hundred and twenty-

five thousand gallons to irrigate the place once. Then you would want one hundred and twenty-five thousand gallons for the second irrigation.

Mr. SAGE. How many irrigations?

Mr. RAWSON. It depends on the season. This fall we have not had to irrigate at all. [Laughter.]

Mr. WILSON. I would like to inquire how it is about the frost in this climate. Would it not spoil the drain pipe?

Mr. RAWSON. Not if laid upon a board.

Mr. WILSON. Would not the frost freeze the water and split the tile at fifteen inches of depth? It certainly would an iron pipe.

Mr. RAWSON. In the winter time? What do you want water then for?

Mr. WILSON. Well, sir, the water is not wanted for use; but if the water is where it will freeze, it will be pretty sure to split the tile.

Mr. RAWSON. I do not understand how the gentleman is going to have the water in the tile and have the ground all frozen around it unless the tile is filled with water before the ground is frozen; and if that is the case, the tile is stopped up somewhere.

Mr. WILSON. I have had experience with a good many thousand feet of iron pipe in the ground, and I have never yet been able to convey water fifteen inches under ground without its being frozen and splitting the pipe.

Mr. RAWSON. I understand you now. That is a different question altogether. You speak of tile and pipe. I speak of the pipe four feet under ground and the tile fifteen inches.

Mr. WILSON. Then I understand the water will leave the tile through the winter?

Mr. RAWSON. Yes, sir. The water will not remain through the winter in the tile; but in the pipe it will remain, and that should be four feet below the surface.

Mr. WILSON. How about irrigating strawberries?

Mr. RAWSON. I have used irrigation for strawberries. I applied the water in furrows, every three feet; or make a little ridge and plant say two feet apart, and let the water run down, a slow, steady stream. I should recommend, in a case like that, not a flood of water, the same as you put on

cabbage, where you get through as quick as you can. On strawberries I should carry my water to the upper end of the rows, and have a little faucet from the pipe at the upper end to go down every furrow, open my faucet, and let the water trickle down. That is the way I water my cucumbers. I only have one man when I water my cucumbers. I arrange the pipe so as to go between the cucumbers, and have an inch faucet; then I set the pump going and open the faucets, and the water runs down all the rows, so there is no necessity for a man at all. When I think I have it wet enough I stop the pump and the water stops too. You will notice that in my essay I say that the cucumber contains the most water of any vegetable. There is only 4.4 per cent of solids in the cucumber, and 95.6 per cent of moisture. It is pretty difficult to get too much water upon cucumbers. I have twenty-five acres on my place, and I could not irrigate them unless I run the pump night and day; it takes me just a week to get through it, then I have to begin again. Now this year, some of you may think it strange that I used a pump at all. I ran my pump six weeks night and day in the months of June and July. I have not run it since. [Laughter.]

QUESTION. I would like to ask Mr. Rawson if he thinks there are many wells from which he could run his pump night and day?

Mr. RAWSON. No, sir. I never saw a dug well from which I could run a pump at all.

A VOICE. Mr. Rawson is situated right on a river, and pumps from the river, or so near it that it is the same as from the river.

Mr. RAWSON. No, sir. I pump from a well sixty feet below the river. My water is taken from a driven well. I never saw a dug well that would supply a steam pump; but a driven well is a different thing, and you can pump from a driven well by striking a current of water that will supply the steam pump. I never have been on a place yet of ten or twenty acres but what I found a current somewhere that would carry a steam pump. One of my wells is sixty and the other is eighteen feet below the bottom of the cellar. Either one of them supplies the steam pump, and they are

both of them upon currents which will flow over the top of a four-inch pipe on a level with the ground, driven down sixty feet. I connect my steam pump right onto it. I have another one in which the water comes up about ten feet in the pipe. It is twenty-eight feet deep. The longer you pump from a driven well the more water there is in it.

Mr. SESSIONS. How did you discover the current?

Mr. RAWSON. By an apple tree — a piece of stick. All I have to do is to step above the current —

Mr. SESSIONS. That is the secret of it. Mr. Rawson has the power which many have heard of — a sort of magic as to discovering water. I do not know whether he can tell us how any of us can do it or not.

Mr. RAWSON. No, sir; I do not believe you can.

QUESTION. I would like to know what encouragement there is for a man in a hill town to sink one of these wells — on the top of a hill where it is rock — to get a supply for the house?

Mr. RAWSON. Is your land all ledge?

Mr. ——. It is ledge after you get down twelve or fourteen feet.

Mr. RAWSON. There are arrangements by which rocks are drilled right through nowadays as well as through soil. If I was on a hill like that I would move off. [Laughter.]

Professor STOCKBRIDGE. I am very deeply interested in the line of remark that has been made. It seems to me, after all, when we consider the whole State of Massachusetts, the farmers of the State and their situation, that this talk about irrigating a domestic garden, or even a market garden, is rather a picayune business. What I want to do is to irrigate a haying lot of one hundred acres, a corn field, a wheat field, on a broad, grand scale. I do not believe we can pump water by steam engines and get water enough for that extended work, and that if we have water enough to irrigate on a grand scale, as we want, we must take it by gravity from some flowing stream. Now, the question I wish to ask is this — the gentleman has probably investigated this matter thoroughly: Suppose the people of Easthampton want to draw water from some stream that is coming down from an elevated section of this town, for the purposes of irrigation,

what rights have they in that stream? Have they the control of that water? Can they take it, or has somebody else the right to the water, and are the farmers debarred?

Mr. RAWSON. The way I understand the law at the present time is, that they have not the right. That is just what has brought me where I am; that very subject. We have no right to take it for irrigation. The town of Arlington gets its water from a pond, which they made themselves by stopping up a basin at the lower end. It is 125 feet above my land, and I offered the town six hundred dollars a year to supply me with water, and they said they could not do it. I said, "Why not?" "Well, because the law does not allow us to sell water to any one for irrigation." There is no objection against people taking it for domestic purposes, but just as soon as I should get it for irrigation, or my plan all made, somebody would come by and say, "Rawson is making too much money, and he can't have it." That is just about the way that is. Now, if we could get the water for irrigation by some law, still not taking it away from the people that have it for domestic purposes, it would be better for the farming community, and for the domestic people, too. But we have no such law at the present time, as I understand it.

Professor STOCKBRIDGE. Then I would like to ask this: Supposing the farmers of West Springfield, all through that basin region, want to build an irrigating canal, such as you have seen in California and in Colorado, and want to take the water out of the Connecticut River above Holyoke, carry it up around that slope, and irrigate a thousand acres below here, have they a right to take that water?

Mr. RAWSON. I do not think they have, according to the law of the State at this time. If they can, it would be the best thing they could do.

Professor STOCKBRIDGE. Then, for the purpose of irrigating here in Massachusetts on a large scale, we are debarred from getting the water, are we not?

Mr. RAWSON. Practically. But I do not know of any way that you can get the water cheaper than for twelve cents a thousand gallons, and I can pump it for that. There is no reservoir that you can make, there are no pipes that you can

lay, and there is no money that you can expend, but the interest would be more than it would cost you to pump this water at twelve cents a thousand gallons.

Professor STOCKBRIDGE. I understand, where Indian corn, wheat, etc., are irrigated, it only costs sixty cents an acre for the water for a year. Can you pump it up and put it on for sixty cents an acre?

Mr. RAWSON. I am talking about Massachusetts, not California.

Professor STOCKBRIDGE. I would like to ask another question. If we have no legal rights to the water of Connecticut River, or any of its branches, for irrigating purposes, I want to know if we have not an undoubted right to take sewage waters of our inland cities, and use those waters for irrigating purposes?

Mr. RAWSON. I think we ought to have.

Professor STOCKBRIDGE. Then had we better not do it? Take the sewage water of the city of Worcester, that is troubling all the valley of the Blackstone from there to Long Island Sound, and which is a great volume of water. Could not that be used for irrigating purposes to great advantage, and would it not be infinitely better water to use than your well water?

Mr. RAWSON. Yes, I think it would be better to use; but of course until we get some act through the Legislature in relation to it, it would be pretty difficult for us to get it, and I am not much of a lawyer myself, and I hope the gentleman will not ask me too many legal questions. But I hope the time will come before long when we shall get some such right; when the farmers of Massachusetts will place men enough in the Legislature to obtain such rights. And I hope that those young men that are now being educated in our Agricultural College will have such instructions, not only in agriculture, but in elocution, parliamentary practice and those points which will bring them before the public, so that they will take their place where they should be, and place the agricultural interests of the State in the position they ought to occupy. [Loud applause.]

I think the gentlemen are wandering somewhat from the subject, and I hope you will excuse me, also, for departing

from the subject of irrigation, because I feel it is very important that our young men in our colleges should be educated a little more in elocution, oratory and parliamentary practice.

The CHAIRMAN. Gentlemen, the discussion upon this subject is now closed. The next lecture will be upon "Hay for Market," by Mr. J. B. Walker of Concord, N. H., a gentleman of ability and experience, whom I now have the pleasure of introducing to you.

Mr. WALKER preceded the reading of his paper with the following words: Some years ago, before the war, Mr. Theodore D. Parker of Boston, a merchant sailing vessels down into South America, had occasion to go down South. The atmosphere down there was decidedly pro-slavery, and it was decidedly anti-slavery up here. It was not particularly pleasant travelling down there. He went out on the Mississippi River and went down three or four days on a steamboat, and had for a companion in his state-room a Mississippi planter. They had a very agreeable time all the way down the river, and took great comfort together. When the boat drew up at Natchez the planter said, "Here I land. My plantation is about a dozen miles out from here, and I would be glad to have you come and see me," and handed him his card. Thereupon Mr. Parker returned the compliment. It seems they had been together two or three days without inquiring each other's name. The planter took the card and read it, started back, drew a long breath, and said, "Is it possible that I have been three days on the great father of waters in company with that pestilent abolitionist, Theodore Parker of Boston?" "Oh, no, sir. My dear friend, you make a mistake. If you will read my card carefully you will see that my name is Theodore D. Parker." "Ah! I beg your pardon, sir. I hope you will excuse me, — Theodore D. Parker. Now, as a friend, will you allow me to give you a little advice? You are travelling in the South, and as you will register, probably, at the hotels, you be very careful to write that 'D' in your name almighty large." [Laughter.] Now, there are four points in my paper of special importance, and I want them written

in our memories "almighty large," for they are important to the safety of our crops, and to the safety of our pockets, if we are going into grass raising.

HAY FOR MARKET.

BY J. B. WALKER OF CONCORD, N. H.

Mr. Chairman and Gentlemen, — I have felt a good deal of diffidence in coming down here into the very garden of New England to speak to some of its best hay farmers upon a subject to which they have given a life-long attention. The responsibility of my mistake, if such it prove to be, must be borne in part, at least, by our mutual friend the secretary of your Board of Agriculture.

I need not say that in New England the hay crop is the great underlying one of our agricultural system; that upon this, directly or indirectly, rest all its various branches; that as we enlarge or diminish this, we may increase or must lessen our stocks of cattle and sheep and horses; and, further, that as these vary in numbers so will vary the manurial resources of our farms, and eventually the pecuniary conditions of our pockets. We once had a sordid old fellow up in New Hampshire, better off than the rest of us, who was wont to say that he always put his pocket-book under his pillow when he went to bed, for "he loved to lie awake at night and hear his notes draw interest." But a higher pleasure by far than that comes to the grass farmer in May and June, as he hears in the night watches the gentle rain descending from heaven upon his meadows of living green, rendering soluble the plant food which they contain, that it may be converted by nature's mysterious processes into glorious expanses of waving grass. He feels that he is co-operating with God himself in the accomplishment of a worthy end.

Our attention just now is directed forward, and it may be well to note, at starting, the mark at which we now stand upon the grass-growing scale; and I am happy to congratulate the Massachusetts farmers upon having attained a higher one than that occupied by those of any of her sister New England States, for the former raise on an average one and seven one-hundredths (1.07) of a ton per acre, affording an

annual of feed of 3,521 pounds to each of their cattle, horses and sheep.* But, if she does stand at the head, is this the best which old Massachusetts can do? I do not think so. Thousands of individual farmers are making better records every year, and there can be no doubt that the average hay producer, having a fair quality of grass land at any point north of Mason and Dixon's line, can double this yield.

Conditions of Success.

There are three requisites to high success in the production of hay, viz.: Maximum crops, superior quality and minimum cost. No one, or even two, of these will insure it. Large crops of high excellence will return little profit if their cost be excessive. Meagre returns of any quality, at whatever expense produced, are never satisfactory. To vary a little the statement of the proposition, the farmer gets the best net returns from good crops of good quality, raised at the least adequate expense

Grass is indigenous to most of our New England soils. It grows by culture, it grows by neglect, it springs up spontaneously everywhere, it is omnipresent. Yet its most profitable production is almost a fine art, requiring a knowledge of its composition, its organic construction and its habits of growth.

Without an intelligent supply of its wants, high success in its culture is as unattainable to the farmer as is good flour to the miller who is ignorant of the peculiar character of his wheat and of the mechanism of his mill.

* STATES.	Tons per Acre.	Acreage.	No. of Tons.
Maine,	.86	1,279,299	1,107,788
New Hampshire,	.87	674,440	588,170
Vermont,	1.03	1,015,620	1,052,183
Massachusetts,	1.07	639,498	684 679
Rhode Island,	.80	102,894	82,646
Connecticut,	1.03	542,495	564,079

In 1880 the hay-consuming animals in Massachusetts were: horses, 59,629; mules and asses, 213; oxen, 14,571; milch cows, 150,435; other cattle, 96,045; sheep, 67,979; total, 388,902. The amount of hay raised, 684,679 tons, or 1,369,358,000 pounds.— *United States Census of 1880.*

Habits and Physical Construction of Grass Plants.

If one should go upon a good grass field, about the first or middle of July, and carefully remove from its bed a cubic foot of soil with all the plants growing thereon, he will find standing upon it about three or four hundred stalks, some two feet and a half or three feet high, surmounted by heads or panicles, and bearing upon their sides long and gracefully bending leaves. A further examination, by carefully washing away the earth from which these have sprung, will reveal an intricate mass of tubular roots interlacing with each other in all directions, the great body of which are confined to the upper four or five inches of the cube. Some, perhaps, like those of the clover, will be found to have penetrated deeper, but as a general rule the upper four-inch stratum of any meadow contains nine-tenths of the grass roots growing upon it.

If he should proceed further still, and analyze any or all of these, he will find them composed of various distinct substances, combined in certain fixed proportions. For instance, a thousand pounds of air-dried timothy hay will be found to contain 143 pounds of water, fifteen and one-half pounds of nitrogen, twenty pounds of potash, one and one-half pounds of soda, four and one-half pounds of lime, one and nine-tenths pounds of magnesia, seven and two-tenths pounds of phosphoric acid, one and eight-tenths pounds of sulphuric acid, and twenty-two and one-tenth pounds of silica.* Without these ingredients within reach, and in assimilable form, the half ton of timothy cannot be produced; and, if nature does not furnish them, the farmer must, or go without his hay.

The Seed-bed.

The first thing which demands attention in preparing for a grass crop is the seed-bed. Nature suggests that it be at least five inches deep, and success is dependent upon its being a good one. It must be so made as to meet all the underground wants of the grass plants, and of such fineness

* Talks on Manures, by Joseph Harris, p. 344.

as to allow their roots and minutest rootlets to wander through it with facility and in all directions. It must be porous to such a degree as to readily admit to its bosom the warmth and air and moisture of the atmosphere above it. Without these life cannot flourish. Destroy a soil's porosity and you destroy the vitality of every living thing growing upon it. Some one hundred and fifty years ago Mr. Jethro Tull of England asserted that tillage was a substitute for manure; and, although his experiments did not sustain his proposition, they did prove that minute pulverization aided greatly in rendering assimilable the plant food locked up in indigestible compounds in the soil, and consequently diminished to some extent the amount of fertilization otherwise required. His efforts, therefore, were not in vain, and his posterity will always owe him a debt of gratitude for the great truth which he unwittingly taught them.

Fertilization.

It may be superfluous, perhaps, to say that adequate fertilization is a *sine qua non* to a good grass crop. You all know and believe it; and yet, if their fields are a true index of their views, thousands of New England farmers do not agree with you.

What kind of fertilizer one should use on his grass fields must generally depend upon the circumstances surrounding him. He will, of course, employ the manures of his farm stock, and if these suffice will need no other. If he does he may be so situated that he can buy stable manure. Perhaps he can obtain wood ashes, and has lands adapted to their use. The spent lime and drench precipitates of a tannery may be within his reach. If he can obtain either of these at remunerative prices they will generally answer fairly his purpose. Whether he can afford to use any of the so-called commercial fertilizers, I am unable to say. My own experience with them, in connection with grass, has been limited and not satisfactory. Further experimentation with these is needed, and some of this the grass farmer may as well conduct for himself upon his own lands, noting with care the nature of his soils and the formulas used. I have strong suspicions that the latter may be economically modified.

The condition in which manure should be applied has received less thought than it has deserved. Its action being twofold, — that of affording plant food to the crop, and, to a greater or less extent, of rendering assimilable that already in the soil, — it is most active when fine and evenly disseminated throughout all portions of it. When applied in lumps, with undressed spaces left between them, it is less effective and the crop is unevenly fed. The mechanical perfection of manurial application is the bringing into close contact a particle of manure with every particle of the soil.

But economy requires that it be diffused through the seed-bed only. As before stated, the great mass of most grass roots lie in an upper strata of soil some four inches deep. In this they seek their food, and in this it should be placed. They will not seek it very much below this depth, and the soluble portions placed there are liable to be lost in the subsoil. If applied upon the surface it will reach its destination only as it is washed down to it by rains, being entirely inert during dry periods, and liable to run to waste where the surface of the ground becomes hard by frost or other cause.

Moisture.

This in sufficient and constant supply is essential to successful grass-growing. I say sufficient supply, for it has been said, and probably with substantial truth, that an ordinary grass crop exhales in growing twice and a half of its weight of water. The "Marcite" or winter meadows of Lombardy and Piedmont, in the valley of the Po,* which bear grass uninterruptedly from the 8th of September to the 25th of the following March, receive during this period successive irrigations of an aggregate depth of eleven hundred and eighty-eight inches or ninety-nine feet. I also say constant supply, because receiving its food in solution, this is largely withheld during periods of drought, causing the crop to languish and mature a stunted growth. The drought which prevailed in the valley of the Merrimack, in 1884, cut short the hay crop about one-fifth of the yield anticipated on the first day of June, and destroyed a large percentage

* Italian Irrigation, by Capt. Baird Smith, vol. 2, p. 107.

of the grass plants, which were restored only by reseeding.* While good grass cannot grow in water, it cannot grow without a full and constant supply of it.

Good Seed.

My attention was called, some years ago, by a valuable member of the Massachusetts Board of Agriculture, the late Capt. John B. Moore, to the great importance of using good seed in farming. A moment's reflection will call to mind the fact that a sound acorn contains a perfect oak in embryo, awaiting expansion in the ground and air. It is also just as true that the maize kernel and the grass seed inclose the undeveloped stems and leaves of those plants. If the seed be withered, feeble or imperfectly developed, it will surely transmit its own constitutional imperfections to the crop which springs from it; and it is just as reasonable to expect a herd of choice cattle from a collection of scrub calves, as to expect satisfactory vegetation from imperfect seeds. The law is general and immutable, that imperfection breeds imperfection just as much in the vegetable as in the physical world. As farmers, we may regard it to our profit, or disregard it to our loss. The amount of poor seed imposed upon the farmers is astonishing to one whose attention has not been called to the subject, and it is one of the causes to which poor crops may often be attributed.

I desire to emphasize these four points to which I have just called your attention, viz.: Properly made seed-beds, adequate fertilization, sufficiency of moisture and good seeds. They are very important, and cannot be ignored with impunity. For that reason I desire to leave them in large letters upon the tablets of your memories.

* The rainfall at Concord, N. H., in 1884, during the grass-growing months of May and June, was as follows: May 5, .28 inch; May 8, .15 inch; May 9, .08 inch; May 10, .02 inch; May 14, .60 inch; May 16, .17 inch; May 20, .67 inch; May 22, .20 inch; May 23, .30 inch; May 28, .60 inch; totals, 3.07. June 6, .25 inch; June 10, .07 inch; June 12, .24 inch; June 24, .10 inch; June 25, .27 inch; totals, .93. On the first day of June the prospect of a good grass crop was most promising. On the first of July all such anticipations had vanished. The rainfall had been less than an inch during the former month, and the crop was a fifth less than an average one. Subsequently the sharp drought of July destroyed extensively the roots of the grass plants.

Obstacles.

The hay producer encounters various obstacles in the prosecution of his business.

Frequently low places in his fields show a deterioration of the quality of his grass, by the appearance of sedges, brakes, etc. This suggests underdraining of the parts affected, if practicable, and if not so, an elevation of the surface. Either will remove the evil.

Now and then a dry ridge will indicate its aridity by a scantiness of herbage. The remedy for this is an incorporation of additional vegetable matter with the soil, or a lowering of its surface to the level of the surrounding ground. The latter course secures largely the avoidance of the impact of dessicating winds and of the rapid drainage from its surface of the rainfall.

But the most serious obstacle by far is drought We cannot control the condition of the atmosphere, and I should hardly venture to suggest any remedy for this malady but for the fact that we must have one. We are situated somewhat as was the boy sent out to catch a woodchuck by his father, where such animals were not plenty, with the imperative remark, "We must have one, for the minister dines with us to-morrow, and he cannot make a dinner without fresh meat." We cannot raise grass without moisture, and fortunately for us we can generally do much to secure it.

The melting snows and spring rains almost always keep the ground sufficiently moist up to the middle of May. If the soil be in good condition, by that time the grass will have attained such a height and thickness as to shield it from a rapid loss of its moisture. The term "good condition," just used, suggests the well-known fact that abundant fertilization is a great palliative of drought.

Dryness of a soil is often due to the fact that, owing to the hardness of its surface, the rainfall cannot penetrate it, and simply runs over and off it, to no good purpose. The maintenance of a porous soil and open sod, by frequent breaking up of the ground and its thorough pulverization, accompanied by reseedings, is a good remedy in such cases.

The harm resulting to mowing-fields from fall feeding comes largely from the compacting of the ground's surface by the tread of the cattle.

As before intimated, strong, drying winds not infrequently rob exposed elevations of their moisture, to the very great injury of their herbage. A practicable remedy for this evil may be often found in belts of trees, so placed as to break the force of the winds and deflect them to a course above and beyond the parts affected. These will also serve to protect the grass roots by preventing the blowing away of the snow in winter, whereby large tracts of ground are often left bare.

There is another remedy for drought which is sometimes practicable, particularly in hilly and well-wooded localities. I allude to irrigation, which, properly conducted, is an absolute specific, as it insures moisture at all times and to any extent.

I am aware that irrigation is seldom practiced in New England, and that one who advocates it is liable to be regarded as possessed of lunatic ideas, which, however, are entirely harmless so long as no money is risked upon them. Yet in Europe, in northern Africa, in India, and in the western part of our own country, it is very common.

We have as yet hardly begun to study the value of our water resources. Until recently those only have been regarded as of much account which had sufficient power to turn a mill wheel. But recently they are being looked upon from a domestic and sanitary stand-point, and the farmer ought to go still further and examine them as agricultural agencies: investigating their channels and volumes, both above and below ground. Thousands of Italian farms are made perennially fruitful by the streams descending the southern watershed of the Alps, and the celebrated "Marcite," or winter meadows, are often irrigated by springs alone. It is time for us to wake up to the fact that it is a reckless waste to allow the thousands of New England brooks to flow idly and uselessly through our pastures and meadows, all the way from their remotest sources amid the mountains, to the great resounding sea.

So far, the few efforts at irrigation in New England which

have come under my own limited observation have been fairly successful, and furnish a perfect protection from drought. Of course, few, comparatively, of our farms have the water requisite for the purpose, but where it does exist irrigation is as practicable and as little ruinous as hoeing corn or digging potatoes. In the Eastern world its success is as old at least as history, and doubtless older.

Hay Raising as a Specialty.

The high price and poor quality of hired labor, unaccompanied by a corresponding price of farm products, has raised the inquiry, Can hay farming be prosecuted as a specialty with profit? It may be said in reply, that it is not easy in New England to so organize the labor on a farm as to confine it to one crop. Still, it may be done, and a farmer possessed of good grass lands, and so situated that he can buy manure at reasonable rates, may find the business a satisfactory one.

I have personally found that about five cords of the best stable manure per acre, applied every five years to good grass land, broken up and seeded that often, will secure an average yield of about two tons a year, or ten tons for that period.

I think that the outlay and returns will not greatly vary from those of the following statement: —

Outlay.

Breaking up one acre of sod ground eight and a half inches deep, with sulky plough, one man at $1.50 per day, and three twelve-hundred-pound horses at $4.50 per day, two-thirds of a day each,	$4 00
Harrowing twice, one man and two horses, three hours,	1 35
Five cords of manure, delivered on land, at $7.00 per cord,	35 00
Spreading same; one man, two horses and manure-spreader one day,	4 50
Ploughing in same; one man and two horses half a day,	2 25
Harrowing; one man and two horses three hours,	1 35
Twelve quarts of grass seed,	1 00
Sowing; one man, one horse and seed-sower one hour,	30
Rolling; one man, two horses and roller, one hour,	45
Use of farm implements, say,	1 50
Cost of harvesting two tons of hay each year, for five years, at $3.00 per ton,	30 00
Total cost of hay, exclusive of rent of land and taxes,	$81 70

The profit realized during the five years will depend of course upon the market value of the hay. This will be —

At $12 per ton, ...	$120	$81.70	$38.30
15 "	150	81.70	68.30
18 "	180	81.70	98.30
20 "	200	81.70	118.30

being $7.66, $13.66, $19.66 or $23.66 per annum, according as the respective prices above-mentioned are realized. While these figures will doubtless vary in different localities, they have sufficient general accuracy to show that well-conducted grass-farming may be made a fair-paying business, particularly in favored localities.

Should these figures seem satisfactory, it may be well to look a little further, as to the amount of labor requisite for the maintenance of a fair-sized hay farm. I will probably be safe in saying that an intelligent, able-bodied man with a good team will break up a tract of twenty acres of Connecticut River meadow in thirty working days; that he will harrow this twice preparatory for manuring in four working days; that, provided he does not have to draw it more than a mile and a half, he will put upon it one hundred cords of manure in fifty working days; that, with a manure-spreader, he will spread this in twenty working days; that he will plough it into the seed-bed in ten working days; that he will harrow the ground twice, after manuring, in four working days; that he will sow and roll in the seed in four working days; in all, one hundred and twenty-two working days. From April 15 to November 15, exclusive of July, left for haying, there are one hundred and thirty-two working days.

If this calculation is correct, one man and team can break up, manure and reseed twenty acres of grass ground each year during the working season, exclusive of the month of July, and have ten days to spare for rainy weather and other contingencies. The other five months, which complete his year, remain for other business. How other considerations may modify the desirableness of this system of farming each individual must judge for himself. That hay-raising as a specialty may, under favorable circumstances, be made practicable and fairly remunerative, there can be little doubt. It requires less hand labor per acre than any other of our

farm crops, except those of wheat, rye, oats and barley. To persons wishing to do some farming, and at the same time avoid the great difficulty of obtaining satisfactory labor at a fair price, it offers agreeable employment and fair compensation. In other words, if I am correct, a single man favorably situated, with a good team and extra help in haying, will manage one hundred acres of grass land, and have the winter left for the disposal of his crop, and such other business as may claim his attention.

Summary.

Such of you as may have visited the late ex-Alderman Mecchi, on his farm at Tip Tree Hall, in England, or have read his books, doubtless remember that he had reduced some of his agricultural experiences to concise maxims. For instance, he was wont to say: "Never use a man when you can use a horse; never use a horse when you can use a steam engine; for an iron horse don't cost half as much as a flesh horse, and will last twice as long." Citing his example as my apology, I beg leave, by way of recapitulation, to condense some of the things I have just said into a few not very elegant dogmatic sentences. I would gladly put them into verse, as did old Thomas Tusser his "five hundred points of good husbandry," but I cannot write as mean doggerel as he did, nor, I am sorry to say, any better, so I must give them to you in plain prose.

1. Raise grass on grass land; for two tons can be as easily raised on an acre of such land as one ton on an acre of a dry and sandy nature.

2. Never let your yield decline to a low point in quantity; for, by so doing, it will decline in quality as well, and a double loss will result.

3. When the grass plants of a field are no longer thick and vigorous, plough, fertilize if necessary, and reseed it; for a yield of hay is in near proportion to the number and health of the plants producing it.

4. Whenever the surface of a grass field has become impervious to the rainfall, break up and reseed it; for grass won't grow without moisture, and moisture will not penetrate an impenetrable surface.

5. Top-dress only porous sod lands, using fine and soluble manures; for it is as vain to top-dress an impervious turf as to satisfy a man's hunger by scattering food upon the skin of his cranium.

6. Never use poor seed, for like produces like; and the breeder may just as reasonably expect good progeny from a mean parentage as a grass grower satisfactory crops from mean seed.

7. Understand perfectly the composition of your soils, fertilizers and grasses. It is the only way by which you can know what you are about. This cannot be done without more or less experimentation by the grass producer upon his own fields. Reading and observation only will not suffice.

8. As a general rule, break up, manure and reseed your grass lands one year before they need it. By so doing you will be more often right than wrong.

9. Raise as little second-class hay as you can; for first-class buyers want first-class hay, which is easiest sold and yields the best profit.

10. Never half manure the seed-bed of a hay field. By so doing one gets half crops of hay, and incurs the labor and expense of two ploughings, fertilizations and seedings, where one might have sufficed.

Our agricultural system is just now in transition from that of a receding to that of a coming period. Wonderful discoveries in natural science are changing it materially, and ushering in the new spirit of a new age, under whose auspices special farming has appeared. It embodies a central idea which is the direct opposite of that upon which our fathers wrought. Instead of a little of everything, it suggests the raising of a good deal of one thing. How extensively it is to prevail, experience has not yet determined. We have something of it in tobacco raising, something in dairying, something in truck farming. We are likely to see more of it in hay husbandry.

Mr. Humphrey of New Hampshire. Mr. Chairman, I suppose the meeting is open for outsiders to say a word. I wish to make the inquiry of my friend Walker whether he has visited the farm of Professor Sanborn, where irrigation is in operation, and has been for years?

Mr. Walker. I have seen it. He commenced irrigation twenty-five years ago, and has kept it up from that day to this. The irrigation is not like the scientific irrigation you will find on the other side of the water; but he has maintained, as I understand it, crops of grass for twenty years mainly without any manure, simply from water alone.

Mr. Humphrey. He has a hundred acres that are under irrigation. I have been all over them. He takes the water from a pond that was a saw-mill pond, and takes it on the upper side and irrigates by furrows led away down the hill. He gets from seventy-five to one hundred tons of hay a year from it, and Mr. Walker said it has been irrigated twenty-five years. I was not aware of it.

Question. Where does he get his water? Is it sewage water?

Mr. Humphrey. No, sir. It is Concord brook water that runs through a pasture, a little brook that nobody cared anything about, that nobody would interfere with the damming of; and by building a dam as long as this hall he makes a pond of about forty acres, and in that pond he accumulates water enough to draw from during the year as he wants it.

Mr. Gold. You spoke of grass seed. Have you had any experience with unhulled seed, such as we used to raise ourselves, compared with the hulled seed, — hulled that we now get in the market?

Mr. Walker. I have not. I buy the best seed I can, the cleanest I can, from examination with a microscope and taking the word of the seller, and deducting what I think is reasonable from his statement; and the result is, I get pretty fair seed. I get some things I do not buy, but I pay for them. I do not get any more seed from having a few extraneous things thrown in than if the seed was pure, and hence I get the yellow daisy once in a while. I have kept clear of the white daisy; but if we get seed that has been injured by wet, or immature seed, we will find sometimes that our grass does not come up to what we expected. Our poor crops of hay are often due to lack of vitality and imperfections in the seed.

Mr. Gold. The sources of our seed are entirely different from what they used to be. We used to raise seed which

was good for all our purposes. It had an inclosing hull on it to protect it. It did not have so many kernels in a pound as the present seed has, but I have a suspicion that a bushel of that seed was a great deal better than a bushel of the hulled seed that we now get in the market. We have many failures of grass seed. We see it come up, and the next thing it is gone. This is so common that I am suspicious that this seed that we now obtain is very inferior in vitality. I have no experimental facts to settle this question, only I have a suspicion of that kind. I am suffering in the seeding of my land in some way that I can account for in no other way than that this seed has been heated on the ground in which it grew, or it was immature, or the fact of its being hulled takes from it a natural shield and protection and invigorator that gave it some stamina to start with, and enabled it to stand the drought and other obstacles in its early feeble state.

Mr. Walker. I do not know where you will get that seed, unless you raise it and thresh it yourself. The only pure seed that I have ever sown is witch-grass seed, and that you probably are not very favorably inclined to. We sometimes sow witch-grass seed, but that you cannot put on the market. At least I never tried. We get enough of that at home. We get that pure, and it always grows well.

Question. Do I understand the gentleman that he seeds with twelve quarts per acre only?

Mr. Walker. Perhaps I ought to explain a little. I seed with twelve quarts of timothy-seed per acre. My land is full of witch-grass. I cannot get rid of it if I would, and I do not know as I would if I could. It sells just as well in the market as any other hay. On some lands I mingle red-top once in a while; but my main dependence, beside timothy, is what comes up, and it is witch-grass seed and perch-grass seed. Now, I do not recommend that for you. If you have no witch-grass seed, I think you had better pray that you may never have it. But if you have it, and cannot get rid of it, then make the best of it. It makes very good hay, and stable keepers will buy it, and give just as much for it as any other.

Question. Do you use any clover seed?

Mr. Walker. No, sir. I raise my hay for market, and you have to give the buyer such hay as he wants. Capt. John B. Moore once said he raised a certain variety of strawberry, the meanest strawberry there was, but the kind of strawberry the Boston people wanted. Now, I try to raise the kind of hay my customers want, and they want as much herds-grass hay as they can get, and do not mind about a mixture of witch-grass. [A question was asked which was inaudible to the stenographer, but Mr. Walker replied to it as follows:] Perhaps I can answer that question best by telling exactly what I do do. I lay down my land to grass whenever I can, from the spring until the time the ground freezes up. If I could do it exactly when I want to do it, I would do it somewhere from the first day of August to say about the middle of September. Now, my mode of operation is this, and here is where I am standing to-day. I have worked up to it from another level. I go on and invert the sod of my land, sometimes during haying when we have lowery weather, and if we do not do it at that time, then just as soon as we can get at it. I plough about eight and a half inches deep. Of late years I have used the Cassidy sulky plough. That turns the sod over and laps one furrow upon another. That leaves the ground pretty rough. I use a harrow to get down a good surface. Sometimes it needs to be harrowed more and sometimes less. I then take a manure-spreader and put five cords of manure on top of that sod as evenly as I can spread it. The end aimed at is to disseminate the manure over the surface of the ground in the finest possible way. When that is done, I have found no better way than to plough that manure into the seed-bed. You take up the turf and you will find the main part of the roots are down about four inches deep. I try to put the manure down all the way from the top to the bottom of that four or five inches. If you take a plough and cut a narrow furrow, and watch it, you will find that as that furrow turns over, this manure spread evenly on the surface will tumble down with it, and some will be at the top and some will be nearly buried. When the field has been well ploughed in that way, we take a harrow and make it as even as we can. I find that with a smoothing harrow I can do as well as with

any other. Then with a seed-sower, about eight feet long, a horse and man will sow an acre in perhaps an hour. When that is done, I put on a roller and roll down the top of the ground and roll in the seed. You asked me why I rolled it in. In the first place, I like to see a good smooth surface. There is something pleasant in the appearance of it; but the advantage of it is that you get a better germination, — a larger percentage of germinating seeds from rolling it than you will if you brush it in, as many people do.

What do you want in germination, when you come to think of it? Why, you want moisture; and you won't get moisture, if you mix your grass seed loosely with the soil. If you can lay the soil so close about the seed as to have the moisture of the soil moisten the seed, then there is one condition of germination secured. Another is, you must have warmth if the seed is going to sprout, and as the sun's rays come down on the soil and warm the surface it gets the warmth, and you get perfect germination. I remember some years ago I was going down the Alabama River, from Montgomery in Alabama to Mobile, going down on a boat, and we had a New York alderman there. This was before the New York aldermen had become as corrupt as they are now. That alderman used to have a sense of duty, and used to go round and visit the city institutions of New York, and he told a story about going to the marine hospital and finding a couple of old sailors there. They were past work, were worn out, and had drifted in there to stay what little time they had, and then were going to die. One morning in the spring, it was a little warm, and those old fellows crawled out and sat sunning themselves. Finally one said to the other, "Jim, we ought not to be spending all our time doing nothing. We are going pretty soon. Can't you think of something we can do?" "Well," says Jim, "I don't know as there is anything to be done, except to write our epitaphs." So they found a shingle and a piece of chalk, and sat down on the piazza, and Jim said to Sam, "Now you begin. You write first and I will write next." "No," Sam said, "You write first." So Jim began it. He scratched his head, put the chalk on the shingle, and finally got started. "Here I lies," and there he stopped. "Here

I lies as snug as," "Here I lies as snug as a bug in a rug." "There," said he, "is my epitaph. You can't beat that." So Sam took the shingle and turned it over, and after scratching his head, he wrote, "Here I lies a darn sight snugger than that other bugger." [Laughter.] Now I think, when you roll in your grass seed, that seed lies a little snugger and is going to germinate better than where you simply brush it in.

Mr. CRUIKSHANKS. Have you had any experience with orchard grass?

Mr. WALKER. I do not know anything about it. I simply raise hay for the market. I am not a scientific man, nor a very learned man. I have seen orchard grass, but I do not know enough about it to undertake to tell you anything.

Mr. WILKINSON. After your land has been seeded down for five years and weeds of various kinds come into the grass, what do you do with them? I think one item in the expense of raising hay is to take care of the weeds.

Mr. WALKER. If you sow late in the fall and use barnyard manure where buckwheat has been pretty abundant, you will be pretty sure to get a crop of weeds in your grass next summer. If you sow as early as August or September, although those weeds are mingled with your manure, frost kills them, and you will have clean hay next year; but I do not think in five years, on good grass land, well manured, that you will get many weeds. If you do, there is only one thing to do, and that is to plough up and reseed.

QUESTION. Can you not mow them down?

Mr. WALKER. Oh, that mowing down does no good.

A VOICE. Plough them up.

Mr. WALKER. Yes, rip them up.

Mr. CHASE. Have you tried top-dressing and found it practicable and economical?

Mr. WALKER. If you top-dress when your sod is, say two years old, it may be advantageous; but if you are going to raise grass, I think we had better use more manure by furrowing it in than to use it in top-dressing. Where you top-dress, and the ground is frozen from the first of December until the middle of March or April, during that entire

period, if that manure lies upon the ground, it is not going through the frost, and as the snow and rain come, and the snow melts, more or less of it becomes soluble and runs off. You may get it in the hollows, but you lose it on the ridges. I do not believe top-dressing is economical except upon an open sod. As a general thing, I say, do not top-dress. I will say one thing more about weeds. We have various weeds up there that make their appearance as a substitute for hay, so when I find my hay crop declining in quantity I also find it declining in quality. If you let grass land lie too long anywhere, you will find more or less of wild stock getting in, and that spoils your crop for market hay.

QUESTION. Did you ever top-dress and follow immediately with a harrow?

Mr. WALKER. No, I never did. My sod is pretty tough, and as I think now, I am inclined to hold my ground on ploughing in. Where I top-dressed I have not had good success. I have top-dressed, and when I came to cut the grass, I could not see that it had done any good. I top-dressed once with nitrate of soda, and I thought I was going to get a good crop. My man said that I got less where I put the nitrate of soda than where I did not. I think I did get a little more; but where I have top-dressed I do not think I have received benefit enough to pay for the dressing. I have a little grass around my door-yard, and I top-dress that, and by putting on enough of it I keep a good sward; but I cannot afford to do that on my grass fields.

QUESTION. What do you think of using the wheel harrow and working the manure in thoroughly as a substitute for second ploughing?

Mr. WALKER. I have tried that, and perhaps you can make it go; but I find I do not get so thorough a dissemination of the manure, so that a particle of manure comes in contact with every particle of soil, as I do by a fine plough. You know when a woman puts yeast into dough she wants the yeast to go through it to every particle of the mass, otherwise you do not get very good bread. And it is so in manuring land. But so far as I am concerned, I can cover the manure better with a fine plough than with a wheel harrow.

QUESTION. How deep do you plough the second time?

Mr. WALKER. I plough just as deep as I can and not disturb the old sod that has been turned over. That is, I plough about four inches or four and a half inches deep on the second ploughing. About one-half of my grass-raising is done on land that is ploughed up, and seeded down immediately. Another portion of it is where I raise oats and corn and so on, and the sod has a chance to lie one year and rot.

QUESTION. You spoke of using a horse-seeder. What seeder do you use?

Mr. WALKER. I began with a little whirligig seeder, putting the bag around your neck and turning a crank; but I have got a seeder that goes on the Victor horse-rake. It is about eight feet long. A man gets on the horse-rake and drives across the field back and forth, and if he is careful to follow his tracks he will get the seed on very finely. All you have to do is to drive your horse.

QUESTION. Can you gauge the quantity?

Mr. WALKER. Yes, sir.

QUESTION. Is it a machine made purposely to go with that rake?

Mr. WALKER. Yes, but you can put it on any rake as well. The machine costs about ten dollars.

Mr. SAGE. We have heard a little about good grass land. What constitutes good grass land?

Mr. WALKER. That kind of land that will bear first-rate grass. [Applause.] Up our way — I do not know how it is down here — we want ground that can be kept continually moist in some way; that is fertile; that is rather cool. Now, the market will stand hay at about the rate of two tons and a half to the acre. When you get three tons of hay, the stable keepers rather shake their heads. I think on good grass lands you get of the first cutting two tons and a half, and sometimes three tons to the acre, and then it will dwindle along down, and at the end of your five years, if you have first-rate land, you will get down to one and one-fourth or one and one-third of a ton to the acre. Then it is time to plough it.

QUESTION. What is the value of hay half timothy and half red-top, compared with all timothy?

Mr. WALKER. I don't know. I raise hay to sell. I think the timothy sells the best of any. I doubt whether it is the best hay. I think those who have studied the subject will tell us that red-top is really better hay than timothy.

Mr. ——. The idea is that clear timothy generally brings the best price; better than when red-top is mixed with it.

Mr. WALKER. Well, people that are very particular like pure timothy hay better than any other; and if it is put on the market in proper shape, you can get a dollar a ton more than others get for hay that is mixed.

Mr. ——. The gentleman does not seem to recommend top-dressing. From my experience in raising grass, it seems to me that I cannot dispense with top-dressing. I agree with him in turning the sod underneath. I agree also with what he says about seeding down, but I could not dispense with clover. If we will put in clover, the root of that clover will make us a great deal of fertility for future crops. If he will top-dress his land when it has been seeded, and seed with clover any time during the month of October of the last two years, if he does not see splendid results I will be mistaken.

Mr. WALKER. What shall I do with my clover? I can not sell it.

Mr. ——. I feed it.

Mr. WALKER. I do not keep any cattle. I am going along trying to avoid poor help, and farm by machinery. I use the least possible amount of manual labor. When you know that fact, perhaps that may explain some things.

Mr. ——. Of course that explains the question to the average farmer of Massachusetts. I do not suppose we can all do that.

Mr. WALKER. But the secretary told me I must talk about hay for market, and the market does not want that kind of hay.

Meeting adjourned to 7.30 P.M.

Evening Session.

The evening session was held at 7.30 o'clock, when William Wheeler of Concord gave his lecture on "Life in Japan." The lecture on "Reminiscences of the Orient," by Pres. H. H. Goodell, was on the programme for this evening, but on account of the illness of Mr. Wheeler was delivered last evening, and is printed here in accordance with the programme.

REMINISCENCES OF THE ORIENT.

BY HENRY H. GOODELL OF AMHERST.

"Many a traveler will remember, no doubt, a sudden thrill on awakening suddenly in the midst of his first night on Eastern soil — waking as it were from dream into dream. For there came a voice, solitary, sweet, sonorous, floating from on high through the moonlight stillness, the voice of the blind Muezzeen, singing the Ulah or first call to prayer. And at the sound, many a white figure would move silently on the low roofs, and not merely like the palms and cypresses around, bow his head, but prostrate, and bend his knees. And the sounds went and came: God is good! God is great! Prayer is better than sleep! There is no God, but God, and Mahomet is his prophet! La elah il Allah! Mahomet raçoul Allah! He giveth life and he dieth not! O thou bountiful! Thy mercy ceaseth not! My sins are great! Greater is thy mercy! I extol thy perfections! And then the cry would be taken up and prolonged by other Muezzeens, and from the north and the south, the east and the west, came floating on the morning stillness this pious invitation to prayer, — this proclamation to all the world of the embodiment of the Moslem creed: There is no God, but God, and Mahomet is his prophet."

Who that has ever been in the East can for an instant lose the impression of that first moment, so vividly portrayed in the above sketch? It is perhaps the most characteristic feature of Eastern life, and one that is repeated daily, again and again, in every Turkish city. A creed so simple and

yet so bold in its utterance! Its very strength lies in its simplicity; and the millions who have lived and died in the profession of its faith, have carried its tenets triumphantly from the shores of the Atlantic to the great wall of China and the heart of further India.

Reminiscences of the East: of the land of the fig-tree and olive, the vine and the pomegranate, the myrtle and rose, the musk and the ottar of Araby the Blest, and the delicious notes of nightingales warbling as though intoxicated with their own sweet song. What images rise up before me and return to my memory! Out of all this luxuriance, what shall I select as my theme?

Shall I tell you of that wondrous city, "alone of all the cities of the world, standing on two continents," massed on its seven hills, and rising tier on tier of swelling domes and burnished minarets, each one a center of refulgent light, yet so toned down and softened under the light of a sky known in no other clime than in the East, so circled round by masses of dark verdure which cluster round the sacred edifices, that the eye finds no inharmonious point, but wanders with recurring delight over the whole?

Or shall I tell you of the great war between the crescent and the cross, when, lying almost within sound of the great guns whose iron hail was crashing upon the doomed city of Sevastopol, we watched the transports sailing by, carrying reinforcements to the allied troops or bringing to the city the thousands of unhappy wretches, gashed and maimed, battered out of the semblance of humanity, or who, stricken down by the insidious attack of disease, had been brought there to linger awhile and die?

Or, once more, shall I tell you of the land itself, its products and resources, the people and their ways, their lives and occupations, their various methods of gaining their daily bread?

It has seemed to me that perhaps this last was the more appropriate. And yet I almost despair of giving you an adequate idea of a country and a people where everything is done in a manner so exactly opposite to our own. The distinction they make between the religious and the moral character is very singular. With us there can be no religion

without morality; but with them the religious has nothing to do with the moral character. The pirate committing murder on the high seas, and taken red-handed, refuses to eat meat on Friday and thus imperil his soul, even while his hands are yet wet with his brother's blood. The robber strips you to the skin, takes everything you possess, maltreats and threatens you with death, and then calmly ejaculates as he leaves you, "May God save you, my lamb, if in danger. I give you into His keeping."

No one is ever supposed to be the less covetous, the less a cheat, a gambler, a liar, a defrauder, a robber, a murderer, because he prays. Nothing is farther from his own thoughts or the thoughts of the bystanders, than that his prayers should exert any transforming influence upon his own character. And why should they? For when they have business to transact with their neighbors on temporal matters they use a language which all can understand, but whenever they have any business with their Maker about their eternal interests it is always done in a language they do not understand. Outwardly pious and sincere, inwardly they are whited sepulchres and full of dead men's bones. The traveler in the highway, the artisan in his shop, the merchant in the bazäar, the lounger in the café, when the hour for prayer arrives, hastens to spread his little carpet on the ground and goes through the required formula. But he is keenly alive all the time to whatever is going on about him, and when his pious ejaculations are ended, will be found to have lost not an iota of anything that may have been said during his temporary fit of piety. If a professional story-teller has been amusing the crowd with some entertaining tale while he was praying, he will be found not to have lost the point of the story, or the pith of any joke. The writer of the article entitled "Baron Hirsch's Railway in Turkey" tells the following story: A peasant one day sent in all haste for an American missionary to come and pray for him. Not a little surprised at the unusual request, the missionary went, and the peasant remarked, "Your prayers are more efficacious than those of our priests." The missionary was somewhat surprised at this, and after modestly murmuring something concerning faith, was preparing to comply with

the request, when the man continued, "I have taken a ticket in the Vienna lottery. If I win through your prayers, you shall have one-half."

It was apparently a perfectly natural thing, this copartnership of earth and heaven, and the peasant could see no impropriety in invoking the prayers of those he considered more potent than he. He put up the money, the missionary furnished the prayers, and they went divvys on the result. What harm?

But to turn from the moral side to the customs of everyday life. The barber, for example, pushes the razor from him; ours draws it to him. The carpenter draws the saw towards him, for all the teeth are set in; ours do the reverse, for the teeth are set out. The mason sits while he lays and trims his stone, ours stand. The scribe writes from right to left, usually upon his hand or knee; ours from left to right, upon the table or desk. Even in the matter of building a house, the same law prevails. We begin at the bottom and finish at the top; the Turks begin at the top, and frequently the upper rooms are entirely finished and habitable, while all below is a mere framework like a lantern.

The Oriental uses a pipe so long that he cannot hold a coal to the bowl, and at the same time draw a whiff of tobacco smoke from the other end. We use one so short that the scent of burned hair too often mingles with that of the fragrant weed. We polish our boots with elaborate care; but these people, whose religion, perhaps, will not allow them to use brushes made from the bristles of the unclean beast, wipe up their shoes with their hands, and then put on the last finishing touches with their handkerchiefs, or the slack of that wonderful thing denominated Turkish trousers. Barnaby, in his "Journey through Asia Minor," quotes a missionary as saying: "The Turks about here are just the bottom-side-upwardest, and the top-side-downwardest, the back-side-forwardest, and the forward-side-backwardest people I have ever seen. Why, they call a compass which points to the north, queblen, or south, just for the sake of contradiction; and they have to change their watches every twenty-four hours, because they count their time from after

sunset, instead of reckoning up the day like a Christian." One more striking point of difference, and we have done. The Turks through long ages led a roving, wandering life in the immense plains of northern and central Asia. Rising from the position of slave and subject to that of master, they gradually fought their way down to the shores of the Mediterranean and occupied the entire territory. But the inherited instincts of so many generations have never been completely laid aside. As in their warlike, migratory state, the tent was to them simply a sleeping-place to which they retired for the night, so the house has been to them ever since. *Home*, in our sense of the word, with all its beautiful associations, has no answering equivalent in their mind, and, in fact, there is no word in their language which can convey such an idea.

To add to the difficulty of giving any adequate idea of the people of Turkey, is the fact that they do not form a single race, amalgamated and blended into one, though made up of different race elements, but are composed of Turks, Jews, Greeks, Armenians, wild tribes of Koords, Turcomans, Kuzel Bash and the Bulgarian, Croatian and Slavonian tribes of the Danubian principalities, each retaining its distinct nationality, its own religious rites, and its own peculiar customs and ways. Of the population of eight millions in round numbers in European Turkey, the Turks number about 3,600,000, and the rest are Christians and Jews. In Asiatic Turkey the proportion is about the same. Of these, the Greeks and the Jews are the tradesmen; the Armenians, the artizans and bankers; the Bulgarians and Croats are agricultural in their tastes, while the Koords and Turcomans live largely by plunder and by the produce of their herds. In such an assemblage of races you would naturally expect to find great differences; and yet, after all, certain distinct features will be found peculiar to all, and certain customs that are common to all.

As a rule, the Turk will be found to be honest and truthful, and living up to the command laid down by Mahomet in the earlier days of his inspiration: "When thou hast given thy word, stand fast by it, and let the words of thy mouth be even as thy written agreement." Of the other races we

cannot say as much. The Jews, as in all ages, are the money-getters, and live and thrive in their quarters, as in the Ghetto of Rome, in a squalor and filth that would quickly exterminate any other race. The Greeks are shrewd and enterprising, but the characterization of the Cretans by St. Paul is no inapt description of their character: "The Cretans are always liars, evil beasts, slow bellies." Their own countryman, Euripides, even before the time of the apostle, wrote, "Greece never had the least spark of honesty;" and Lord Byron, twenty centuries after, one of the most enthusiastic in their cause, exclaims, "I am of St. Paul's opinion, that there is no difference between Jews and Greeks — the character of both being equally vile."

The Armenians, on the other hand, are a purer, simpler race, retaining much of that individual nationality which made them formidable in the days of the Romans. But contact with the outer world — with the foreigners pouring into Turkey — is changing their character for the worse. It need hardly be said that the farther you go from the capital and the large cities, the simpler and more innocent the lives of the people.

In nothing is this difference of nationality so strikingly manifested as in the cemeteries. The Turks plant theirs with the cypress, and at the head of a grave where a man is buried, a stone is erected crowned with a turban, or, in more recent times, with the national emblem — the fez. At the foot of the grave a plainer stone marks the resting-place of the woman. The turban is absent, and in its place the top of the stone is rounded or pointed, while a running vine is worked around the outer edge. The inscription is very simple — only the name of the family of the deceased, and a recommendation of his soul to the only living and true God. A beautiful custom prevails, both among the Turks and the Christian population, of hollowing out two small cavities in the tablet covering the grave itself, which are kept filled with seeds and fresh water to attract the birds to come and build their nests near by and sing their songs over the graves of the departed.

The cemeteries of the Jews are in keeping with their daily life. As their object is so to live as not to attract attention

and thus call down upon themselves the persecution of their neighbors, so the resting-places of their dead display the same neglect and want of care. Nothing drearier or more desolate can be imagined. Not a tree or shrub to relieve the melancholy waste. Nothing but the barren hill-sides, strewn for miles around with gray slabs, lying in the most terrible confusion.

Not so the Greeks and Armenians. Choosing some beautiful site, as in the "Grand Champ des Morts" at Constantinople, overlooking the Bosphorus and the Marmora, they plant the stately palm or the graceful terebinthus [turpentine], erect a coffee-house and make it the fashionable resort. Its cool and airy situation, its agreeable shade and the convenience of comfortable seats afforded by the tombstones, make it a pleasant promenade. Here, on the flat tablets, the elders mark out a rough board and play games of chance or checkers, or perchance discuss the merits of their ancestors sleeping quietly beneath. Here lovers wander arm in arm and whisper their fond nothings, undisturbed by ghosts of former days. And here the gallants, as they sip their wine, order so many Roman candles burnt in honor of their ladies. The occupation of the deceased is always protrayed upon his tombstone, an adze or saw representing a carpenter; a lancet, a barber; an anvil, a blacksmith; an inkstand, a scribe or lawyer; and if, perchance, his end has been hastened by violence, the manner of his "taking off" is faithfully portrayed. Here you may see a representation of the deceased upon his knees, holding his head in his hands, while jets of blood spout from his neck in stiff curves, like those issuing from a beer bottle on a tavern sign. There you may see the fatal bowstring adjusted about the neck as he awaits the tightening of the cord. These representations carry with them no associations of infamy or crime. They are but the heraldic quarterings to be found among the aristocracy of other nations, and if they had a name would be called the "scimetar pendant, or the bowstring displayed in a field azure." Only, instead of being blazoned upon the carriages of the living, they are placed upon the tombstones of the dead, for they signify that the wealth of the deceased was sufficient to excite the avarice of the reigning power.

"To die, then, by the sword or bowstring, implies the possession of wealth, and the surviving relatives glorify themselves in perpetuating this record of financial standing and consideration."

To the observant traveler in the East, one of its most noticeable features is the absence of farm life among its inhabitants. Between village and village you rarely meet with isolated farm-houses or cultivated areas. You pass directly from the town or hamlet, with its surrounding gardens and arable land, into a wild, unbroken territory, infested only by wild beasts and lawless men. From motives of security, the people all live together in the villages; the farmer going to his farm, two or three miles away, every morning, and quitting work an hour before sundown, to return to his distant family. Even in the neighborhood of large cities you find this to be the case, and within fifteen miles of Constantinople itself, with its million or more of population, could still be shot, only a few years ago, wild boars and wolves in the dense forests surrounding the Bents of Belgrade.

Another very noticeable fact is the utter disregard of fertilizers. Great heaps of manure accumulate in the sheep-folds, the poultry-yards and horse-stables, which are allowed to waste from lack of knowledge of their value. It is true that on the banks of the Euphrates and Tigris, where are grown the celebrated melons, three of which make a camel's load of say six hundred pounds, a hole is scooped in the sand, a handful of hen or pigeon manure thrown in, the seed planted and nature left to do the rest. But this is the exception to the rule. Nor should we blame these people too severely, when we have such bright and shining examples of the same pernicious practice in this country. In California, in the vicinity of Santa Barbara, the manure is hauled, not to the field, but to the public highways, where it is carefully spread to keep down the dust; and in Canada the farmers were reported only this last summer as dumping it by the cart-load into the rivers.

The droppings of the cow, on the other hand, are carefully preserved, worked up with coarse straw and stubble, and dried for winter fuel; for over large areas the woods have

entirely disappeared, and the poor people have no other resource. The preparation of the winter's supply is especially the duty of the women, and, to quote the words of the veteran missionary Van Lennep: "We have watched them collecting the manure from the track which the cattle follow in going to pasture in the morning, shaping it into round cakes, six or eight inches in diameter, by handling it as they would a lump of dough, and with a skilful twist of their hand suddenly sticking it on the walls of their houses to dry in the sun. They seem to enter upon this duty as a matter of course, and conduct it with an artistic dexterity which proves that it is one of the accomplishments of the good housewife much to be desired."

As to the distribution of the arable land, we may make the general division into villages and "Chifliks," or farms of considerable extent. The common farmers live in villages for safety. They may own the land around them in common, but generally each man has his own. The commune system is mainly in European Turkey, and is the ancient system of the Slavic race.

The "Chifliks" or large farms are usually owned by Turks, and vary in size from several hundred to as many thousand acres. They constitute a village in themselves. The landed proprietor in the center, usually on an elevated bit of ground, and the huts of his dependents clustered around and below. It is only the old feudal system revived. The lord in his castle, and the hovels of his humble retainers grouped about the walls. These large estates are devoted principally to grazing; but if there is good wheat land you may see immense fields of grain, from which a good yield is considered nine to ten bushels for one of sowing. The crops are never measured by the acre, and the above yield would probably be not over twenty bushels to the acre.

The threshing floor and its implements and operations would interest an American farmer in the very highest degree. Frequently a whole village will unite in constructing one for common use. A description of such an one from Hamlin's "Among the Turks" may not be uninteresting: "I examined one that was about one thousand feet in length, and, say, one-third of that in breadth. It was made by

hauling on to it hundreds of loads of clay and coarse gravel. The whole was made into mortar, and spread some five or six inches deep on a level, well-prepared surface. It was then tamped every day by a force of men, that went all over it twice a day, until it became too dry and solid for further work. It is now artificial stone. Its inclination from a level is just enough to keep it clear of water. With occasional repairs, it lasts for generations. About three-fourths of this floor is given to threshing, the rest to winnowing. The grain from the field is spread six or eight inches deep over the floor, and then the whole animal force of the village is turned in upon it, — horses, donkeys, mules, horned cattle, with carts and drags, or with nothing but the feet." But the most effective, the finishing-off instrument, is doubtless that referred to by the Prophet Isaiah (xli., 15-16), where he says, "Behold, I will make thee a new sharp threshing instrument having teeth:" And this *having teeth* is what I desire especially to bring to your attention. In appearance it looks very much on the upper side like a common stone drag or boat. It is of plank, about three inches thick, of the toughest wood, and studded on the under side with sharp flints. The edges of these flints, after having been driven into the socket chiselled out for them, are trimmed sharp, and thus completed it makes a most savage-looking implement. Seated on this, with a long pole to prevent the bundles from riding up over the bow, the driver urges on his bullocks. As it goes round and round the area, it cuts and bruises the straw fine, and this, with the chaff, takes the place of hay, for cattle feed in the East. The threshing process over, there are two raking operations, — one to clear off the coarse straw not good for food. This is piled up as worthless chaff to be burned. Then follows a skilful raking off of the finer straw without taking up the wheat. After being passed through sieves, which let the wheat and chaff pass through but retain the coarser stuff, it is ready for the winnowing. This is accomplished by tossing the wheat high into the air, from shovels made of beech, with long, elastic handles, to allow the breeze to carry off the lighter particles. Two more siftings, in sieves of different sized meshes, complete the operation. The wheat thus cleaned

looks well, but oh, the labor! Thousands and thousands of bushels are injured or destroyed annually by the rains before the threshing is over; for at best, even with several threshing floors, it will take a number of weeks for all in the village to have their turn. Efforts have been made from time to time to introduce more perfect machines, but the attempt has always been viewed with distrust by the natives, and dark hints have been mysteriously circulated of the agency of the Evil One. We all remember the story of the opposition to the penny post in London, and how it was denounced by the long-headed ones as an "insidious Popish contrivance." History only repeats itself; and it was this same conservative spirit that Sir Walter Scott satirizes in his "Antiquary," when he puts into the mouth of Mause Headrigg the following objection to winnowing machines: "It is a new-fangled machine for freeing the corn frae the chaff, thus impiously thwarting the will o' divine Providence, by raising wind for your leddyship's use by human art, instead of soliciting it by prayer, or patiently waiting for whatever dispensation of wind, Providence was pleased to send upon the shieling hill."

The other implements of husbandry are very simple and primitive. The ox-yoke is made of two straight pieces, one above, the other below the neck, the top piece alone being hollowed. Two straight pins serve instead of the yoke to inclose the neck, a strong trunnel in the middle taking the place of staple and ring.

The plough is absurdly ridiculous. Take a pole about ten feet long, four or five inches in diameter at the butt; and by mortise and tenon unite this at a slightly acute angle to another piece of about equal size, sharpened and shod with iron to plough the earth, and variously provided with some sort of a handle for the ploughman's hand, and you have an Oriental plough. It does not turn a furrow, it simply scratches the earth to the depth of four or five inches, and then the ground must be cross-ploughed in order to secure anything like an adequate preparation for the sowing. European ploughs, to which several pairs of buffaloes were attached, have been introduced at various times, but were soon given up on account of the difficulty of finding animals

strong enough to draw them. The hope of success lies in the improvement of the breed, but there is something beyond this, for the best breeds introduced soon degenerate from lack of nourishment. The country must be better governed, property made more secure, before farmers will find it to their advantage to give their cattle more than the scanty grass they can pick up here and there on the parched hill-sides. The improvement of implements will follow as a matter of course. The same thing is true of the ordinary horses; barley and straw alone, and the treatment received through many generations, has produced the small, wiry, enduring hack of Asia Minor, as far removed from the lithe form and airy grace of the Arab steed as light is from darkness.

The spade is triangular in shape, with a straight handle, longer than a man is tall. A few inches above the blade, a piece of wood is mortised in, upon which the foot is set, to force the blade deep into the earth. The length of the handle enables the laborer to lay his whole weight upon the extremity, and afterwards use it as a lever in order to raise a large quantity of soil which he merely turns over. "Shallow ploughing but deep spading seem then to be the two chief rules of Oriental agriculture."

The hoe has a broad blade, not flat, but slightly concave, the handle very short, compelling the laborer to crouch to his work. The sickle is about the same form as our own. The scythe shorter, heavier, clumsier, the snath nearly straight, with but one handle, the left hand grasping the snath itself. The blade has no curve worth mentioning. Fortunately for the back of the laborer, hay is in so little demand that the scythe is practically only used in the cradle, and that not by Turks, but almost exclusively by the Bulgarians. As you pass by the great wheat fields you will see men and women with their sickles slowly and laboriously reaping the golden harvest. Ask them whether they could not do the work much more rapidly and easily with the cradle, and they will answer, "Doubtless." Ask them why they do not use it, they will reply, "Good Lord! it is not our custom." And *that* is the end of all controversy with an Oriental. To change the custom of his fathers is as

impious an act as to defile the bones of his ancestors or curse his grandmother.

One is sometimes in despair of any progress in the Eastern world. The beginning must be made at the root. Educate the youth, and they are as ready for improvement as any people. In some places on the rich lands of the Danube, modern implements of harvesting have been introduced, and the produce doubled, because the farmer is no longer afraid of sowing more than he can gather. The women do a great deal of work in the fields, and may be seen laboring side by side with the men. The position occupied by them may be fairly well illustrated by the following story: A gentleman riding one day in the country overtook a man who had laden his wife with a heavy bundle of sticks. He remonstrated with him, saying, "My good man, it is too bad that you should load your wife down in this way. What she is carrying is a mule's burden." "Yes, your excellency," the man replied, "what you say is true. It *is* a mule's burden. But then you see Providence has not supplied us with mules, and he has supplied us with women." It is the same all through the East. Sir Thomas Munro, in his "Travels to the City of the Caliphs," relates as a reason why an Indian should be exempt from paying his tax that he pleaded the loss of his wife, who "did as much work as two bullocks."

Stuart Wood, in a recent number of the Quarterly Journal of Economics, says: "The agricultural processes of different countries are among the surest indication of the condition of the laboring population. In Germany it is a common sight to see a cart drawn by a woman and a dog. Where labor is dearer and money more plenty, or the people a little easier, a horse releases both alike from their unnatural task. In the United States, where labor is dear, costly agricultural machinery is extensively used in spite of the smallness of the farms. It is much used in England also, because there the farms are large; and wages, although lower than in the United States, still far exceed those of other countries. In Russia, on the other hand, in Turkey and in Asiatic countries, we find the rudest tools; baskets are used instead of wheelbarrows, wooden ploughs instead of iron ones; and gangs of spade men replace both the ploughs and

the beasts which draw them. A part of this is no doubt due to sheer stupidity, but much is also due to the price of labor and the rates of interest."

The products of the soil are as various as the climate and geological character of the country. Fruits are abundant, of excellent quality, and extensively used by the whole population. Grapes are delicious, and within reach of the poorest, selling at the rate of two pounds and three-fourths for two or three cents. Apples, apricots, peaches, cherries and plums have their localities of abundant growth, but no attention is paid to obtaining the best kinds, or improving those already possessed.*

Of grapes, whoever has once partaken of the famous "chaoush" from the Bythinian side of the Bosphorus, will forever eschew all others: thin-skinned, small-seeded, fine-pulped, — a dream, a delight, — something to be talked about, *never* to find equalled. The vineyards of the Christians and the Moslems differ in one very important particular. The former cultivate those kinds suitable for making wines; the latter, those that are best for food. While the one are making spirits, the other are preparing that grape molasses called "pekmez," which is extensively used. In it, all manner of fruits are stewed or boiled, and the preserves laid aside for winter use. With it, savory dishes of quinces and meat, or chestnuts and meat, are prepared, much relished by the poor.

The olive is grown over a very wide area, especially in Asiatic Turkey and the Mediterranean islands. It is a universal article of food. Give an Oriental bread and black olives for a lunch, and he is happy. Add to this olive oil to flavor his stewed beans, his clam and rice, and his salads, and he is happier. Beyond that it is not necessary to go. The olive orchard in the flowering time is one of the most beautiful sights in the world, — the gnarled and twisted trunks hoar with age; the short, oblate, slightly curled silvery leaves; the branches fairly bending beneath the weight of the snowy petals, and the ground beneath and around white as with flakes of snow. Job says, referring to this peculiarity of its shedding its blossoms, "He shall cast off

* I am largely indebted to Hamlin's "Agriculture of the East" for my facts.

his flowers as the olive." Next to the cereals, it is by far the most important agricultural product of Turkey. Its berry, pickled, forms the chief article of food; the oil, produced from its pericarp, seasons most of the dishes, and keeps alive the light that cheers the winter's gloom; its wood, close-grained and hard, takes on a beautiful polish and is very highly prized; while its bark and leaves, possessing certain febrifuge principles, are much sought after by the leeches of the country. The tree is slow in reaching maturity, but after the fifteenth or sixteenth year it bears on indefinitely, and seems never to lose its vitality. There are trees in the garden of Gethsemane estimated to be one thousand years old, still in full sap and vigor. It is of all fruit trees the hardiest, for scarcely any amount of mutilation, any severity of frost, or even sharp scorching by fire, suffices to destroy its life. "So long as there is a fragment remaining, though externally the tree looks as dry as a post, yet does it continue to bear its load of oily berries; and for twenty generations the owner gathers fruit from the faithful old patriarch. This tree also requires but little labor or care of any kind, and, if long neglected, will revive again when the ground is dug or ploughed, and yield as before. Vineyards forsaken die out almost immediately, and mulberry orchards neglected run rapidly to ruin; but not so the olive. Though they may not have been attended to for half a century, yet they continue to be a source of income to their owners."

These peculiarities Virgil observed and carefully noted in his Georgics nearly two thousand years ago: —

> "But, on the other hand, no culture needs
> The olive tree at all; not it the knife
> Forthcurved expects, nor clinging hoe, when once
> It in the field is fixed, and bears the breeze.
> To it the earth, its bosom loosened up
> By furrows of the ploughshare's hook-like tooth,
> Sufficient moisture gives, and gives the plough
> Returns of weighty fruitage rich and ripe."
>
> — GEORGIC, II., p. 420.

> "Why, cleave an olive tree's dry stump, and, strange
> And wondrous strange to tell, an olive root
> Will from the dry wood come!"

Frequently a whole village will unite and plant a grove in common. Then not even the berries that fall to the ground are allowed to be picked till a proclamation is issued by the head man of the village or the governor of the province. A tree yields from ten to fifteen gallons of oil, and the profits are about one hundred dollars to the acre. It is claimed that the tree bears only every other year; but this is due probably to the vicious manner of gathering the fruit, — beating the branches with long poles to shake off the berries, and, in so doing, bruising and destroying the tender buds that are setting for the next year's crop.

The husks with which the prodigal son would fain have filled his belly, and which Scripture says the swine did eat, were not after all such very poor fare. Many a repentant sinner might go farther and fare worse. They are the fleshy pods of the locust tree, a leathery brown when fit to eat, some eight to six inches in length, containing a spongy, mealy pulp, of a sweet and pleasant taste in its ripened state, and in which are imbedded a number of shining brown seeds, very hard, and somewhat resembling a split pea. These seeds are of no value whatsoever, on account of their bitter flavor; but the sweet pulp of the pod, when dry, is extensively used as an article of food, particularly among the laboring classes. In Syria it is ground up into a coarse flour, and a species of molasses made, which is used in the preparation of different kinds of sweetmeats. As food for horses it is exported in large quantities into the south of Europe. Into this country and Great Britain it finds its way, under the name of locust beans or St. John's bread, receiving both names from the ancient tradition that they are the "locusts" which formed the food of John the Baptist in the wilderness. The tree is cultivated extensively in all the countries bordering the shores of the Mediterranean, both for its food-producing qualities and its wood, which is hard, and susceptible of a fine polish. In size and manner of growth it resembles an apple tree, but is more bushy and thick-set. It yields a prolific harvest, and it is not unusual to see a tree bearing over half a ton of green pods.

One other tree deserves mention, not on account of its food-producing qualities, but for its importance in a com-

mercial point of view. It is the shrub oak, — the *Quercus ægilops*, — which, growing wild on the mountain slopes and rugged steeps, where nothing else will grow, gives employment to hundreds of men, women and children, who, in the season, go out to gather the acorns. These are brought down in sacks to the nearest sea-port, whence they are exported, thousands of tons annually, under the name of "valonia," to be used in the tanneries of Europe. They readily command eighty dollars to ninety dollars a ton; and, from the sea-port towns of Smyrna and the islands adjacent, forty thousand tons have been sent to England alone in a single year.

The cereals of the empire do not differ much from ours. The exports are barley, maize and wheat. Rye, oats and millet give good results, and there are various other seeds of good native use. Looking only at the soil, climate, industrial population and the rivers and coasts of her great inland seas, Turkey ought to be our formidable rival in the markets of Europe; but her state of paralysis is such that nothing is to be apprehended from that quarter. Destructive treaties with England, and stupid legislation on the part of her own government, have reduced her to a state of hopeless bankruptcy.

Turkish agriculture and horticulture furnish all that the heart could wish in the shape of edible vegetables. All that we produce is there produced, with the exception of potatoes, which are imported from Europe: squashes of various kinds, and measure unlimited; okra, spinach, celery; melons, unrivalled in flavor and size; cucumbers of any length you choose.

The people of the East eat hardly any meat, but live almost wholly on vegetables. The same regimen that made the three Israelitish captives at the Babylonian court so much fairer and fatter than those fed on the king's meat, seems to agree remarkably with the people now. Given a little rice, some unleavened bread, a few olives, a cucumber cut up with garlic and seasoned with oil, and a pound or two of grapes or other fruit, and you produce those miracles of strength to be found in the Turkish porters, who, adjusting the burden to the pack they carry on their backs, walk off with a load of from five to seven hundred pounds, and make nothing of it.

Tobacco is grown in many parts of the empire, but it is a government monopoly, and the taxes levied upon the unhappy cultivators are so burdensome that they are gradually being forced to give up the business. The finest tobacco, distinguished for its mild character and exquisite flavor, comes from the hill-sides of Latakia, a sea-port town of Syria. It is a little singular that smoking, introduced into the East not earlier than the seventeenth century, should have taken such deep root that the Turks and the Persians are now looked upon as the greatest smokers in the world. Men, women and children, with consummate skill, roll up their little cigarettes, — for they are never purchased ready made; and the yellow stain on the finger tips is as characteristic a mark as the black on the hand of a printer's devil.

Coming now to the farm-yard, we find it abundantly provided with animal life. In every part of Turkey domestic fowls are met with, and the traveler always finds eggs and chickens, if nothing more. In European Turkey large flocks of geese and turkeys are raised for the Constantinople market, and are driven down from the inland farms, a distance even of one hundred and fifty miles. This task is usually performed by gypsies; and we have often wondered at the unerring precision with which, with their hooked sticks, they would suddenly arrest some lunatic goose in full career of wings and feet. The hens are transported in crates on the backs of horses.

The Turkish horse is a smaller, hardier animal than ours. It is more tractable, less nervous, has a better disposition, and rarely runs away. It is broken only to be ridden, and not driven; for, outside of the city of Constantinople, there is not a pleasure carriage to be found in the whole empire. In the cities all loads are carried on the backs of the porters, or, suspended on poles, are carried by two or more of the same class. In the country are to be found only the rudest kinds of carts, drawn by bullocks or buffaloes, — the wheels cut out of a solid piece of wood four or five inches thick; and, as no grease is used, the terrible squeaking and groaning that is made, as the carts lumber along, remind one, as it has been quaintly said, of "all the pandemonium of hell let loose."

The horses of the sultan's stables, and of some of the

pasha's, are magnificent creatures, wholly or in part of Arab blood. But the larger proportion of the horses met with are of a very inferior breed. The Turkish cavalry is well mounted, but the horses are far lighter and smaller than those in the English or French service; and during the Crimean war there was nothing attracted so much admiration as the splendid horses of the allies. The sultan, and, indeed, the whole Turkish government, jealously guard the Arab race of horses, that no infidel foreigner may ever possess the pure breed. The pure-blooded Arab mare is never to be sold or given away to a foreigner, nor can the Moslem take her with him outside of the country. It may be doubted whether it ever has been done, and whether, in the cases claimed, the blood is pure and the pedigree sure.

Perhaps no one is better qualified to speak of the Arab horses than the traveler Palgrave, whose command of the Eastern languages was such, that, in the guise of a native, he penetrated into the very heart of Arabia, and lived for months unsuspected among the people. Nay, in one of his journeys in Turkey, he actually officiated in one of the mosques in place of the regular priest, who had been taken sick. Practicing as a physician in the Nejed district, where the race of horses is the purest, and having been permitted to see and examine the stud of the sultan, he says: "Never had I seen or imagined so lovely a collection. Their stature was, indeed, somewhat low, — I do not think that any came fully up to fifteen hands, fourteen appeared to me to be about their average; but they were so exquisitely well shaped that want of greater size seemed hardly, if at all, a defect. Remarkably full in the haunches, with a shoulder of a slope so elegant as to make one, in the words of an Arab poet, 'go raving mad over it;' a little, a very little saddle-backed, just the curve which indicates springiness without any weakness; a head broad above, and tapering down to a nose fine enough to verify the phrase of 'drinking from a pint-pot,' did pint-pots exist in Nejed; a most intelligent yet singularly gentle look; full eyes; sharp, thorn-like little ear; legs fore and hind that seemed as if made of hammered iron, so clean and yet so well twisted with sinew; a neat, round hoof, just the requisite for hard ground; the tail set

on, or rather thrown out, at a perfect arch; coats smooth, shining and light; the mane long, but not overgrown nor heavy; and an air and step that seemed to say, 'Look at me; am I not pretty?' Their appearance justified all reputation, all value, all poetry. . . . But, if asked what are, after all, the especially distinctive points of the Arab horse, I should reply, the slope of the shoulder, the extreme cleanness of the shank, and the full, rounded haunch, — though every other part, too, has a perfection and a harmony unwitnessed anywhere else."

No Arab ever dreams of tying up his horse by the neck. The tether replaces the halter. A light iron ring furnished with a padlock encircles the hind leg just above the pastern. A rope is attached to this, and made fast to an iron peg set in the ground. To make of their horse a devoted friend is the end sought after by all Arabs. With them he leads, so to speak, a domesticated life, in which, as in all domestic life, women play a conspicuous part, — that, in fact, of preparing, by their gentleness, vigilance, and unceasing attention, the solidarity that ought to exist between the man and the animal. A sustained education, daily contact with man, — that is their grand secret; it is that which makes the Arab horse what he is, — an object worthy of our unexceptional admiration. No wonder the Arab poets sing, with the metaphor and hyperbole peculiar to that glowing clime: "Say not it is my horse; say it is my son. He outstrips the flash in the pan, or the glance of the eye. His eye-sight is so good that he can distinguish a black hair in the night-time. In the day of battle he delights in the whistling of the balls. He overtakes the gazelle. He says to the eagle, 'Come down, or I will ascend to thee.' When he hears the voice of the maidens, he neighs with joy. When he gallops, he plucks out the tear from the eye. He is so light he could dance on the bosom of thy mistress without bruising it. He is a thorough-bred, the very head of horses. No one has ever possessed his equal. I depend on him as my own heart."

The famous Arab chieftain, Abd-el-Kadr, who for so many years gloriously resisted French aggression in northern Africa, betrayed unhappily by fortune, but saved by history, prepared, while languishing in confinement in France, a series

of maxims concerning the horse and its management, that are worthy of close attention. His method of judging a horse is "to measure him from the root of the mane close to the withers, and descend to the end of the upper lip between the nostrils. Then measure from the root of the mane to the end of the tail bone, and if the fore part is longer than the hind part, there is no doubt the horse will have excellent qualities. To ascertain if a young horse will grow any more, measure first from the knee to the highest point situated in the prolongation of the limb above the withers, then from the knee downwards to the beginning of the hair above the coronet (to the crest of the hoof) ; if these two measures are to one another as two-thirds to one-third, the horse will grow no more. If this proportion does not exist, the animal has not done growing ; for it is absolutely necessary that the height from the knee to the withers should represent, in a full-grown horse, exactly double the length of the leg from the knee to the hoof."

And now, with a few choice maxims from the same hand, I must pass on to other themes : —

> No one becomes a horseman until he has been often thrown.
>
> Thorough-bred horses have no vice.
>
> A horse in a leading-string is an honor to his master.
>
> Whoso forgets the beauty of horses for that of women, will never prosper.
>
> Horses know their riders.
>
> The best time of day for giving barley is the evening. Unless on a journey, it is useless to give it in the morning.
>
> Water a horse at sunrise, and it makes him lose flesh. Water him in the evening, and it puts him in good condition. Water him in the middle of the day, and you keep him as he is.
>
> During the great forty-day heats, water your horses only every other day.

The pious Ben-el-Abbas — Allah be good to him ! — hath said : —

> "Love horses and take care of them.
> Spare no trouble ;
> By them comes honor, by them comes beauty.
> If horses are forsaken of men,
> I will receive them into my family,
> I will share with them the bread of my children ;
> My wives shall cover them with their veils,
> And cover themselves with the horse-cloths.

I ride them every day
Over the field of adventures;
Carried away in their impetuous career,
I combat the most valiant.
My steed is as black as a night without moon or stars.
He was foaled in vast solitudes;
He is an air-drinker, son of an air-drinker.
His dam also was of noble race, and our horsemen have named him the javelin.
The lightning flash itself cannot overtake him;
Allah save him from the evil eye."

The mule needs no remark. He is the same useful, hard-working, unpopular animal in Turkey as in America. He has the same moral obliquity of character, and the same uncertainty in his business end, as elsewhere. His great usefulness in the transportation of goods makes him worthy of better treatment than he receives.

The donkey, the poor donkey, is everywhere in the way. He is the common bearer of a certain class of burdens in all the cities. You meet him in every street. He crowds you to the wall with protruding load. Everybody curses and kicks him, while he is doing his best. He carries all the sand, lime, bricks, boards and lighter timbers for building. He carries away all the refuse of every kind. He is the most useful, abused and patient of animals. Men, women and children ride him. He always leads the caravan of camels, mules or horses. Everybody uses him; nobody loves him; everybody abuses him. The Eastern world could not live without him.

The prince of burden-bearers is the camel. He is in truth the "ship of the desert." He bears enormous loads, of from six to eight hundred pounds, twenty-five to thirty miles a day. But for him all inland commerce would cease. From the far-off, isolated hamlets of the East he gathers up and brings down to the sea-port towns, or to the few through which a railway passes, the products of the country, and returns laden with the merchandise of Europe. Awkward beyond description, with his short body and long neck and legs, moving noiselessly over the ground with his soft-padded feet, you wonder, and yet shrink from him. Diabolical in expression, he is ugliness personified.

In the breeds of cattle there is room for great improvement. There are none of superior breed; and beef of good quality is not to be found in Turkey. The best quality, which is imported, is from south Russia. Until the time of the Crimean war such a thing as a beefsteak was hardly known. It was mutton, mutton everywhere. Well do we remember the first morsel of steak we ever tasted. It was fried in a frying-pan, done till there wasn't a drop of juice in it, and came up garnished with garlics and onions, and covered over with parsley. But what a flavor it possessed! "Something original and authentic," as Howell puts it, "mingled with vague reminiscences of canal-boat travel and woodland camp." Like the Englishman "who had no prejudices," from that moment I hated mutton.

The ox is small and hardy, but for heavy draft the buffalo is in constant use. This ugly-looking animal, whose paradise is a mud-hole, into which he can sink with the exception of his mouth and eyes, is very powerful. The female gives a milk that is rich, though somewhat strong and odorous. The manufacture of butter is infamously bad. The churns used are of various kinds. Earthen jars, shaped like a barrel, swelling in the center, are filled with cream and then tilted up and down. The trunk of a tree, hollowed out and boarded at both ends, is hung to a beam and swung to and fro. The skins of animals, particularly the goat, with the hair inside, are sewed in the form of a bag, and, being filled with cream, are rapidly rolled over and over on the ground until the butter comes. The gypsies, it is said, when starting on their journeys, will fill the skins with cream, and, sitting upon them, will find butter when they have reached their journey's end. It is said that in early times the missionaries used to punish their children by putting them under the table and making them shake a bottle of milk. Sawing the butter is a very necessary operation, and all well-provided families have a fine-tooth saw with which to extract the hairs from the butter. The natives melt the butter for cooking, and easily strain out the hair. But no attempt is ever made to eat it on bread. A missionary on the rich plains of the Sangarius tried to introduce a reform in the process of churning. He showed the farmers that in the markets of Constantinople their butter

brought less than one-half the price of good English or Italian butter. He tried to introduce the American churn, and the mode of working, salting and putting down. It is needless to say the attempt was an utter failure. They had always *had* hair and butter together, and they always would have, till death. In Proverbs (xxx., 33) we are told that "Surely the churning of milk bringeth forth butter, and the wringing of the nose bringeth forth blood:" There would seem to be, at first sight, no special analogy between the process of churning and pulling a man's nose until the blood comes, if you consider our method alone. But, in the native operation, the comparison is a just one and natural; for the women seize and squeeze and wring the milk in their goat-skin bottles in a vigorous way which would soon fetch the blood if applied to the nasal organ of some antagonist.

The mountains and plains of this great empire, both in Europe and Asia, afford unrivaled facilities for the keeping of sheep. In the summer the flocks pasture on the mountain slopes, while the shepherds with fire-arms and dogs keep careful watch against the attacks of wild beasts. In the winter, immense flocks migrate from European Turkey into the milder climate of Asia Minor. There is such an enormous extent of vacant pasture land that no expense is incurred, except in the transportation of so many animals across the Bosphorus or Dardanelles.

The fat-tailed Caramanian sheep are the most singular and surprising animals to be met with in Turkey. While yet lambs, the tail begins to broaden and thicken with a fat which is regarded by the natives as a great delicacy, and equal to butter for cooking purposes. In a few months the weight and size of the tail becomes a positive burden to the animal, furnishing, in those creatures that have been carefully fed and tended, from fourteen to twenty pounds of pure fat, superior to lard, and entering into competition with butter. If, as often happens, the end of the tail drags upon the ground, so as to endanger excoriation, a very simple though laughable remedy is resorted to. A little carriage, rudely made, with wheels of about six or eight inches in diameter, is placed under the end of the tail, which is thus sufficiently sloped out from the body, and is so harnessed to the lord

(or lady) of the tail, that it is borne about without injury, and may "laugh and grow fat" at its leisure. You may thus often see a sheep going on foot, and its tail following in a carriage. The natives will tell you that these carriage tails sometimes produce seventeen okes (forty-six and three-quarters pounds) of pure fat; but the Oriental imagination is prone to get the better of the real facts, and the figures above given (fourteen to twenty pounds) are perhaps nearer the truth. It is sufficient to know that the tails do sometimes become so heavy as to anchor the sheep and cause its death, if suitable precautions are not taken.

According to a recent article in the "Country Gentleman," these sheep are found in Syria, Egypt, north Africa, Asia Minor and western Asia, and were described by Herodotus and Aristotle more than two thousand years ago; but the writer could not resist adding a pound or two to his tale, and he claims that "animals are not rare whose tails weigh from one hundred to one hundred and twenty pounds, while the average weight is forty to sixty."

Another fact is peculiar about the flocks of sheep and goats. The ewes are milked as regularly as we milk our cows, and it is done with wonderful rapidity. Two grasps of the overflowing udder, and it is emptied. Among my earliest recollections is that of a flock of goats being driven every morning to my father's door and there milked, in order to insure our receiving our day's supply of the lacteal fluid in its virgin purity. Immense quantities of cheese, made from the milk of sheep and goats, moulded into disks of twelve to fourteen inches in diameter, and an inch thick, are transported from the interior of the country to the markets of the great city.

Of the Angora goats, with their long, fine, silky hair, natives of the rocky slopes in the province of Angora, I have not the heart to speak. From the silky fiber of their hair, skilled workmen had long supplied the world with rare and high-priced goods of female apparel. But, with the priceless blessings of free trade, the country was flooded with a cheap imitation made by machinery. The flocks dwindled away, the occupation of whole villages was gone, and abject poverty and ruin overtook the wretched inhabitants.

You will perhaps have noticed the absence of any allusion to the swine among the domestic animals enumerated. The reason is obvious. Considered as an unclean beast by both Turk and Jew, it is only in Christian villages that they are to be found. What was cursed under the Mosaic dispensation and continued under the Mohammedan, is still looked upon with suspicion by the faithful; and, though their mouths may water as the delicate aroma of roast suckling pigs arises on the air, yet they rigidly abstain from any participation. Two infallible signs, one negative and one positive, disclose the character of a Christian town in Turkey, — the absence of minarets and the presence of pigs. In consequence of the pig being in this manner a Christian animal, there is an oppressive tax on pigs, levied when the animal is three months old. The risk incurred from the payment of so large a tax (ten piasters) on so young an animal, is so great that many of them are killed shortly after birth, and an important article of food is lost to the peasantry.

I have lingered longer than I intended, for one reminiscence has led on to another; but I cannot close without alluding to one more fact which must be patent to every thoughtful observer traveling in the Levant to-day; and that is, the constancy of the Eastern mind to itself, and the immutability of its customs and observances. The same scenes penned by the writers of Holy Writ two thousand years ago are repeated to-day unchanged.

Rebekah still lets down her pitcher at the wayside fountain, and helps the thirsty Labans to a refreshing draught.

The tender Ruths still glean where Boaz reaps.

The Miriams still dance and sing the song of triumph, as they go forth to welcome home their conquering heroes.

The women still in humble posture grind their corn, as, sitting on the ground, they whirl the upper grindstone round upon the nether one.

Still, at the evening meal, reclined about the table, raised but a few inches from the floor, they dip their piece of unleavened bread into the common dish, just as in the days when Jesus said, "He that dippeth his hand with me in the dish, the same shall betray me."

Adjourned to Thursday, December 6.

THIRD DAY.

The meeting was called to order at 9.45, and was presided over by Mr. C. L. Hartshorn of Worcester, who introduced as the first speaker Mr. S. W. Clark of Plainfield, who presented the following lecture upon "Co-operative Dairying."

CO-OPERATIVE DAIRYING.

BY S. W. CLARK OF PLAINFIELD.

This subject of co-operative dairying has been presented to the public for several years at farmers' institutes, grange meetings, meetings of this Board, by the agricultural press, and by talented newspaper correspondents and learned professors, until it is worn threadbare. It has been presented in every conceivable light, and there remains really nothing that I can add. That was my first thought, when requested by our secretary to present the paper; but, upon second consideration, it occurred to me that I might present some facts that had come to my knowledge in the practical organization and management of a co-operative creamery, conducted on the cream-gathering system. That is what I shall call your attention to, leaving arguments and theories mainly to others.

Organization.

A co-operative association is a stock company, chartered under general laws, by the commissioner of corporations, upon application made by the officers of the company, who are chosen by the stock-holders, consisting of a secretary, treasurer and five directors, who elect the president from their number. The amount of capital, number of shares, the size of the same, and their by-laws, are optional with the company, all being agreeable to the several provisions of chapter 106 of Public Statutes relating to the same.

Buildings.

The main building should be a substantial structure, frost-proof, if possible. For the manufacture of eight hundred to one thousand pounds daily it should be about forty-five feet by thirty-five feet, two stories high, the upper being a tenement for the butter-maker and family. The lower story should be fourteen feet between joists, and may have a bank wall on the back side six feet high; and a drive-way so arranged that the cream-cans can be taken from the gatherer's wagon by a crane, and swung into the building onto a platform as high as the top of the tempering vats.

The work-room should be at one end of the building, eighteen to twenty feet wide, and thirty-five long, containing elevated tank for water, with a pipe conveying steam for heating the same; shafting sinks; an abundance of pure spring water, also ice water from a tank above; and all necessary machinery and utensils for churning, salting, working and packing the butter. The floor of best cement, slightly concave, with a drain in the center, which, with its branches, will carry all slops, and the eaves' water, with as great velocity as the location will allow, to a stream of water. Another drain is required to convey the butter-milk a sufficient distance from the creamery to an underground frost-proof cistern, from which it can be pumped for feeding pigs or carting away. These drains are provided with traps, and, if properly laid and flushed frequently, will be sweet usually even in hot weather without the use of chemicals.

The next room, thirty-five by fifteen feet, is for the tempering vats, three in number, holding upwards of five hundred gallons, standing on an elevated floor, so that the cream will flow from them into the churns, and so placed that their faucets can be operated from the work-room. The lower floor is of cement, inclining to the rear, so that all slops will run into a drain.

The remaining room should be partitioned for a refrigerator in the rear; the middle can be used for a store-room, and the front for an office. An L, one story, thirty to thirty-five feet long, twenty to twenty-four wide, to contain

the boiler and engine. Fuel next, and at the farther end a cement sink in the floor, furnished with a water-pipe from the main, throwing water through a nozzle with the force acquired from nearly two hundred feet head; also a steam jet from the boiler in the bottom of the sink. This department is used mainly for cleansing the cream-gatherers' cans. Our machinery and fixtures were furnished by the Vermont Farm Machine Company of Bellows Falls. Boiler twelve horse-power, horizontal tubular return flue, set in masonry; engine, eight to ten horse-power, of the vertical, throttle-valve pattern. We use wood for fuel. Two No. 9 Davis swing churns, Hanley's jacketted gathering-cans, and the tempering vats so arranged that we can cool them with ice water or heat with steam, have all proved very satisfactory.

The Eureka butter-worker we have set aside for a home-made one, but intend to try a power-worker soon, and the foot printer for Carver's printer, worked like a cooky cutter. With this our butter-maker can stamp one pound in eight seconds, or seven in a minute. Our patrons are all required to use the Cooley elevator creamer. We furnish all with printed instructions and rules, requiring a strict regard to cleanliness of cows, stables and all utensils used. Cows must stand on an elevated floor, and feed that can give the milk an unpleasant flavor, including musty fodder, and cotton-seed meal above two quarts per cow per day, are strictly prohibited. Milk must be strained three times. Adulterated, impure or gargety milk cannot be used. We recommend a temperature of forty-two to forty-five degrees for the water in creamers. Cream-gatherers are instructed to report any violation of our rules. Patrons disregarding these rules, or furnishing cream off quality from any cause, are first kindly informed of their error; if they make no effort to improve, we, after the second or third complaint, order our cream-gatherer to *pass them*, allowing them to make good butter from *defective cream if they can.*

Factory Management.

The cream is strained into the tempering vats as soon as brought in, and kept at a temperature that will ripen it for churning early the next morning. This requires care and

skill, as the acidity of the cream affects the flavor of the butter. We churn slowly, by concussion, which brings the butter in the granular state.

The buttermilk that will flow is drawn through a sieve into the proper drain; what remains is washed out with cold water. We then wash the butter with water warmed to sixty degrees; this leaves it in the best condition to salt and work. We use Genesee salt, one and one-quarter ounces to the pound, unless ordered otherwise. Have orders for butter with *no salt.* The granular butter and sifted salt are thoroughly mixed, and, if convenient, allowed to stand a short time; then worked, but not too dry, and immediately prepared for market by packing in tubs or printing, usually in one-pound size. The highest degree of cleanliness *must* be observed in the factory at every step.

Business Management.

The directors usually meet each month to advise and share the responsibilities with the president or business manager. The cream-gatherers' books are footed as often, and a statement made showing all receipts and expenses; also each patron's share of the net proceeds of the business, which amount is paid to him from the 20th to the 25th of each month. The *quality* of butter made in this way may not be essentially better than some of the patrons might have made at home, but it is as good as the best, and uniform in quality. A dealer may order a small quantity or a ton, to be delivered a part this week, or later, and it will be not only all *good,* but uniform. So that I can send a dealer a single tub for a sample; if that is satisfactory, we can fill his order, however large it may be, and that will be equally so. The keeping qualities of creamery butter are superior to average dairy butter. We have sold tons of it to packers who have held it for a rise, and, so far as I know, have always been successful, never losing a penny on our butter by holding it as long as the state of the market required. This they could not so safely do with average dairy butter, the stock story that creamery butter will not *keep* to the contrary notwithstanding.

These are some of the reasons why the price of creamery butter has been higher than dairy butter in all our leading markets. This fact can be easily proved by reference to market reports. The difference in price in favor of the creamery has been for some years, and probably will be for the future, fully equal to the total expense of making and selling the factory product. So that the dairyman who troubles himself with the labor and care of making and selling his own, buying salt and boxes, etc., and in many cases taking the risk of working his wife or mother into a premature grave, does it all, not only for nothing, but at considerable loss. In the quantity of butter made, I suppose I am now on *new*, and some may think on doubtful, ground. But I fully believe that in a well-conducted creamery a greater gain is realized by its patrons in the increased quantity of butter made than in the higher price it brings.

Case No. 1 was a trial for two weeks in March, 1887, with a small dairy, using small, open tin pans and a dash churn. The next two weeks the cream from this dairy was sold to our creamery, all other conditions being as nearly as possible the same in each case, and the price at which the butter sold not varying half a cent per pound. The amount of money realized by this patron was a little over 36 per cent in favor of the creamery. The price being the same per pound, surely it follows that the gain was from an increase in the product.

Case No. 2 was a test for one year with twenty-two cows, using a Cooley creamer and barrel churn. The cream during the next year was sold to the creamery. The price per pound in this case did not vary half a cent; but the increase in money realized was 17 to 18 per cent, due allowance being made for all changed conditions. Other cases have been reported to me more pronounced even than No. 1; but not being conducted by myself, and perhaps not with due care, I will not vouch for them; will only add that our creamery has over sixty patrons. I have interviewed many of them concerning this point. Nearly all know that we are making more butter for them than they formerly made. All were satisfied; a few keep no accurate accounts, and could make no reliable statement.

THE CREAM-GATHERING SYSTEM.

I will refer to only three of the more important advantages of this system.

First. The skimmed milk is left on the farm, where it has a two-fold value, as by feeding to calves and swine it is converted into a superior fertilizer. If carried away, as in the whole milk system, it is selling the farm by the milk-can, and its value must be replaced by the purchase of other fertilizers.

Second. The expense of cream-gathering is by far the larger item on that side of the account; but the expense of collecting whole milk must be far greater, as it has four or five times the bulk and weight of the cream alone.

Third. It is the most equitable, as the keeper of highly fed Jersey cows may get eighteen spaces or more of cream per can, while poor stock, half fed, will give their owner less than half that quantity. Each sells just what cream there is in his milk, and no more. The value of the cream per space is very nearly the same in either case. I have endeavored to show that by this system of making butter we produce a superior quality; that we can produce probably 20 per cent more of it; that we can sell it at an advanced price, that will more than pay for the total cost of manufacturing; that the dairy-maid, mother or wife has no labor or care whatever with the cream or butter, only the pails and cans and strainer to wash. The dairyman has no salt-boxes or tubs to buy; has cash for his cream once a month, brought to his hand. We favor our patrons by buying feed per carload, giving them wholesale rates on small lots. Each patron may know what the others are doing. This stimulates a friendly rivalry. Nearly all keep more cows than formerly. Within about fourteen months six or seven carloads of cows have been brought from New York State and absorbed by us, besides many smaller lots bought nearer home. Many are testing their cows, weeding out the poorer ones, improving the better ones by giving better care and feed, learning that all these things pay, — "pay cash every thirty days." The many benefits of co-operation have long been recognized and utilized by men in other branches of manufacturing and trade,

but the small farmer seems to have been "left out in the cold" until the last; but now, wherever this system of co-operative dairying is available to him, he and his family can be greatly benefited. Of the one hundred and twenty-five creameries in New England, our State has its proportion. But we have not half — no, probably not one quarter — enough of them. Not long ago there was a great cry in some localities, "All are going into creameries. Creamery butter will glut the market." In fact, the market for this grade of butter is continually improving. Our creamery now has orders far exceeding the amount we can supply. Here let me say that we have made during the year about ninety-six thousand pounds of butter; it was sold for above twenty-six thousand dollars. The expense of selling and collecting has been no greater than I formerly incurred in marketing the product of my dairy of twenty cows. Note the saving, — the product of sixty-five to seventy dairies marketed at no greater expense than that of one.

I have met but very few dairymen who sang in the minor key. The burden of their song usually is, "I am doing very well now. My wife makes better butter than any one else about here; this dealer or that city boarder said so. They want all we can make." Some will say frankly that they can make just as good if not better butter than any creamery, — minister A. or Dr. B. said so, — when they are selling at a considerably less price than our patrons are getting. These people need instruction. They should understand that a creamery butter-maker is an expert, besides having a great many advantages not available to themselves, the disadvantages being nearly all on their side. The low price they sell at, compared with what the factory product brings, should convince them. As a class, they are the last to see the benefits of co-operation. Their business habits have an influence in this direction. Each works his own little farm in his own way, selling his surplus near home, usually to an acquaintance, — knowing very little of the wholesale market prices. "Paddling his own canoe," with very little regard for the bustling world outside, he is very liable to *get left*. How can we reach and benefit this class? It is not very largely represented here to-day; very

few of them will ever read this paper; they do not believe much in book-farming. "Creameries are all well enough," they say, "for fancy farmers, but my old way is good enough for me." If you press them with too much zeal, they will class you with lightning-rod men and swindling tool agents, and say, by their looks, "You can pass on; we can take care of ourselves." Yet this class would derive more benefit by patronizing a co-operative creamery than any other. One of this class, after being with us a few months, said: "I never took any comfort in dairying before. Now everything goes right." Before, he sometimes had white specks in his butter, sometimes it would come *soft*, and sometimes he would churn half the night, and then his butter would not come. Some believe that this is caused by witches in the cream, and nothing will drive them out but a red-hot horseshoe dropped into the churn. This I was told with all seriousness. While much has been done to give the laboring class practical instruction, something still remains to be done. I believe the creamery has "come to stay." It has a mission as an educator, as a helper of those in an agricultural community least able to help themselves. It should be encouraged, and every practicable means used to disseminate a knowledge of its methods and its benefits. But I have fully occupied the time allotted me. Hoping that this essay has been, in a measure at least,

> "Judicious, clear, succinct;
> The language plain, the sense well linked.
> I told *not*, as *new*, what everybody knows;
> But, new or old, I hasten to a close."

The Chairman. I regret very much indeed that there are so few present to hear this paper and listen to the discussion that will naturally follow, for it does seem to me to be of great interest to the New England farmer. But it is going to be printed in our report by the secretary later, and I trust the farmers will read it. I propose now to call upon two or three gentlemen from neighboring States to talk to us, and I will first call upon Mr. Bachelder, Secretary of the New Hampshire State Board of Agriculture.

Mr. Bachelder. Mr. Chairman and gentlemen: I cer-

tainly feel very much honored in being called upon to say a few words, for I well know the liberal policy which has been manifested in your State with regard to agricultural appropriations, and I also well know the interest which the farmers have taken in the discussion of this subject. While I feel a sense of honor, I certainly feel it would be more fortunate for you and for myself, and for your secretary, to let me sit quietly by and listen to the discussion. You all know that I come from a State of rugged soil, in which we have our proportion of rock and thin soil; but I am pleased to say that the State of New Hampshire, in the year 1887, increased her number of horses, increased her number of cattle, increased her number of sheep and number of swine, an aggregate value of half a million dollars. I cannot, of course, give you the specific reason for this, but we think there are three reasons which have largely contributed to this result. First, the establishment of creameries in our State has been a powerful incentive to the farmers to keep better stock. The grange, which is doing a powerful work there, has increased the work in various directions among farmers. The subject of ensilage, which we hear of so often in our agricultural meetings, has led our farmers to keep more stock, and to keep them in a better manner. We have to-day twenty co-operative creameries, that manufactured during the year 1887 a little over six hundred thousand pounds of butter, that returned to the farmers of that State a net price of twenty-two and one-half cents per pound for the milk or cream furnished to make a pound of butter. This is the average price returned from the creameries of the State. Of course there are exceptions to this price. One creamery, for instance, returned only sixteen and two-thirds cents, while another creamery returned over twenty-seven cents.

Question. Did the one returning sixteen and two-thirds cents run all the year round?

Mr. Bachelder. Yes, sir. I presume the reason for the small price which they were able to return was the fact that they did very little business. I think they worked up the product of something like one hundred and sixty cows. This gave a very small product in proportion to the invest-

ment, and made the cost of making the butter very high. Now, the question has come to us in our agricultural meetings: Can you produce a sufficient amount of milk or cream to make a pound of butter for twenty-two and one-half cents? We all know that the real object in farming is to get the market price for our hay and for our grass and for the grain which we feed. Now, during the present year, I have experimented in a little way on a herd of grade Jersey cows on a farm at East Andover, and I have kept an accurate account of hay, grain, and cost of pasturage, to see if I could produce a sufficient quantity of cream or milk to make a pound of butter for twenty-two and one-half cents. The year is not quite out, but it is near enough so I can draw pretty correct conclusions in this case.

QUESTION. How many cows?

Mr. BACHELDER. I have twenty grade Jersey cows. They will eat during the year not far from two tons of hay each. This hay, in our market, is worth $12 per ton at the barn. I presume it is worth more here in your State. They will eat about eighteen hundred pounds of grain each, which will cost me about $21. This will make the cost of the hay and grain $45. I then allow $7 per cow for pasturage and taxes, making the cost of keeping each cow per year $52. Now, for the result. I shall be able to produce from each of those cows 225 pounds of butter, which, at twenty-two and one-half cents per pound, would come to $50.62. I shall be able to get from the skim milk from each of those cows $10, making $60.62 from the product of each cow, leaving a profit of $8.62. By careful experiments that I have made this year, and made in previous years, I find that I can get about four cents for the skim milk left after making a pound of butter. I do this in feeding to pigs, and killing them before they are eight months old.

QUESTION. Is the calf of any account in that matter?

Mr. BACHELDER. The calf, so far as my experience has been, is of no account. I dispose of the calves in any way that I can, as soon as the milk is good.

QUESTION. Is there any difference between the interest on the money invested and what you would be obliged to pay, provided you hired those cows?

Mr. Bachelder. I reckon the pasturage at six dollars. That is about what it is worth there. Then I reckon one dollar on each cow for the interest and taxes I do not know as that would be perfectly correct, but it is as I estimated it.

Mr. Ware. Would it not be about six or seven dollars really that ought to be charged to the account for the use of the cow for one year? Have you allowed anything for the depreciation of the cow?

Mr. Bachelder. I purchase my cows, and I am usually able to get as much for them when I get through as when I bought them. Sometimes they depreciate; but it is seldom that I have a cow but what I get as much for her at the end of the period as I gave, and for that reason I made no account of the matter.

Mr. Sessions. Your cows cost you about $50 apiece on the average?

Mr. Bachelder. About $50 dollars apiece. The question was asked what I get for butter. I have been able to sell the butter for the last year for no fancy price. I have been able to sell it for no more than any farmer in the State of New Hampshire or Massachusetts can get for butter of the same quality. I have been able to get an average for the year of twenty-eight cents per pound. In the manufacture of the butter I have practiced a little system of co-operation, which it seems to me can be practiced to advantage in other sections of the State, and perhaps in Massachusetts. Now, we are situated ten miles from a creamery. If we were near a creamery, I should probably put the cream in there, and have it manufactured by the butter-maker, and save the work of manufacturing; but we are so far away that we have to do another way. My practice is this: I sent my man to a practical butter-maker, and let him learn what he could of the business in a short time; and he came home and went to making the butter, and he has not only made the butter from my twenty cows, but he has made the butter for a neighboring farmer who has twenty more, so that I am running a co-operative creamery on a small scale now. I pay the farmer for his cream what the creamery would pay him. He gets the price for his cream that he would get from the creamery, almost at his own door, and I have been

able, as I say, to make butter in this way that has brought twenty-eight cents a pound. In regard to the price of skim milk, I have kept an accurate account, and I am sure it is as I have stated. One year ago I bought a lot of small pigs, and fed them skim milk for six months. At the end of six months I had paid for the grain they had eaten, and had $89.60 left for the skim milk, which enabled me to realize about one-half a cent per quart. In keeping the record for the year, it has brought me about $10 per cow.

Mr. Ware. You say you pay $50 for your cows. I suppose they are new milch cows, and that you realize as much when you sell them. I do not see how you can do that, unless you keep them another year, and sell them as new milch cows; and, if you keep them year after year for a period of four, five or six years, there must be a depreciation in the value of the cows. That was the point I alluded to in my question.

Mr. Bachelder. When I purchase a cow that does not prove what I think she ought to, if the feed does not go to the production of milk and butter, she will take on flesh, and I dispose of her for beef; and, if she proves a good milker, I keep her a number of years. I have not been in the business long enough to know how I should come out in the end; but the cows are worth what I gave for them now at the present time.

Question. I would like to ask the gentleman what an average Jersey cow will bring for beef when you turn her?

Mr. Bachelder. Well, the cows of the size I have bring from $40 to $50. Mine are grade Jersey. I do not keep any thorough-breds.

Question. How much does it cost to fat a Jersey cow?

Mr. Bachelder. Well, I could not tell you in regard to that. The only point I wish to state is, we can produce milk and cream to make a pound of butter for the price which has been realized from it by the creameries of the State; and, also, that this little system of co-operation which I have practiced can be carried on by two or three farmers in other sections of the country, where they could not avail themselves of the creamery.

The Chairman. We have present with us to-day Mr.

James Cheesman, Secretary of the New England Creamery Association, and we shall be pleased to hear a few words from him at this time.

Mr. James Cheesman. Mr. Chairman and ladies and gentlemen, I esteem it an honor to be invited to address you to-day, because the audience contains many men who are much older than myself, — men who have grown gray in the business of dairying; and I feel keenly the responsibility that devolves upon me in addressing you who have had so much longer experience than I, although my experience has been derived from a pretty wide area. What I have to say in the few moments allotted me will be to notice some points brought out in the practical address from my friend behind me, evidencing in a very marked manner the value of co-operation, which was so very thoroughly indorsed by the speaker who followed him. At the present day I think we must all be convinced that, without some form of co-operation, it will be utterly impossible for us to hold our own against the gigantic corporations that are growing up. With co-operation it will be quite possible to do it, and we shall derive profit in doing it. I was very much pleased and instructed by the reference to the co-operative purchase of food supplies. Some fifteen years ago, my first experience in agricultural pursuits was entirely in that direction. In England the members of the Agricultural Society had suffered so severely for a number of years from the adulteration of seeds, food supplies and fertilizers, that it became a matter of self-defence for them to undertake to supply these articles on a co-operative basis. The object was not so much to divide the profits among themselves, although that received serious consideration, as to secure a supply of pure foods, fertilizers, and seeds of guaranteed power of germination. I want to ask Mr. Clark what kinds of foods they buy, and whether they have undertaken the preparation of compound feeding-stuffs at the creamery that would stand up to the formula they prefer for the production of the best quality of cream in the manufacture of their butter.

Mr. Clark. I will state that our purchases have been confined mainly to wheat-bran and oats. We can usually

purchase our corn about as well as to buy it by the carload. Our wheat-bran we buy in large quantities, and cotton-seed in limited quantity.

Mr. CHEESMAN. Do you prescribe any standard?

Mr. CLARK. No, sir. We prohibit an undue quantity of cotton-seed, that is all.

Mr. CHEESMAN. There are some questions I would like to ask Mr. Clark, because the value of all these meetings depends on the number of questions presented, and without these questions it is impossible to have that interesting discussion which results from their presentation. One question is, Do most of your patrons adhere to a temperature of forty-two degrees?

Mr. CLARK. We instruct them to, and, so far as our cream-gatherers are concerned, they say they are conforming to that requirement.

Mr. CHEESMAN. Has the cream-gatherer power of inspection over all details?

Mr. CLARK. Yes, sir.

Mr. CHEESMAN. Do you use paper or cloth in making your pound prints?

Mr. CLARK. We use paper.

Mr. CHEESMAN. How long do you set it aside?

Mr. CLARK. Sometimes, if we are crowded, we give it very little time; but if we can, half an hour or a little longer.

Mr. CHEESMAN. Is that sufficient?

Mr. CLARK. I suppose not strictly; but it answers.

Mr. CHEESMAN. How large are the granules?

Mr. CLARK. Oh, we intend to stop churning when the granules are about the size of a buckwheat kernel, or a little finer.

Mr. CHEESMAN. You must all have noticed, some time last week, that a combination in Chicago, interested chiefly in the manufacture and sale of oleo-butter, had organized a conspiracy against creamery butter, by forcing up the price to a very high figure. I think one day the quotation was forty cents a pound. It seems to me, if the system of co-operation exists in the State of Illinois, that it is exceedingly dangerous practice to permit those interested in oleo-butter

to manipulate the real butter market in the way they have been doing of late. It can result in nothing but injury to the butter interest ultimately, and I am inclined to think that before very long something of the kind may be attempted in the Eastern States, — may very likely originate in New York City, — and make it a very necessary matter for the creameries in the Eastern States to adopt some form of co-operation for the purpose of controlling the distribution of their butter. It is not sufficient to sell butter on the open market, and allow it to pass into the hands of the oleo-butter manufacturers, or those interested in its sale, and leave them to use their enormous influence in the manipulation of the butter market. Sooner or later, I am inclined to think, the creameries will have to control the distribution throughout to the consumer. That is a very serious matter, and I commend it to all interested in co-operative dairying, for deliberation.

After what has been said by the writer of the paper, I think we can entertain no doubt of the success of co-operative dairying. Wherever private dairying, so called, successfully competes with co-operative dairying, it is only by the adoption, to a greater or less extent, of the same mechanical methods of butter-production, and the same methods of business organization, as has been illustrated by what our friend Mr. Bachelder told us All the makers of fancy dairy butter, so called, are wealthy owners of cattle kept for breeding purposes, and usually men owning very large herds, able to keep well-qualified butter-makers, who can produce the same quality, or very nearly the same quality, the year through; and so it commands those gilt-edged prices which are so common with men who practice private dairying of the higher class, so that practically there is no essential difference between the successful private dairyman and the co-operative dairyman. The question which presents itself for our consideration is this: The average farmer is usually the owner of a small herd, and cannot adopt the same methods throughout; and, if he did, it would render his butter-making unnecessarily expensive, as has been illustrated to us by Mr. Bachelder. You may remember he quoted the case of one creamery in New Hampshire

which sold its butter at sixteen and two-thirds cents per pound, because they were receiving the cream of one hundred and sixty cows only. My friend behind me represents a creamery receiving the cream of eight hundred cows. Their expenses, probably, are about four cents, or four and a quarter.

Mr. CLARK. It has been as low as three.

Mr. CHEESMAN. That is unusually low. I think the average expense of manufacturing, cream-gathering, and marketing butter produced in New England creameries, runs about four and one-half cents to five and six-tenths, which is exceedingly low. Manufacturers of dairy utensils, of very much longer experience in the New England States than I have had, tell me that the cost of production on private dairy farms, and of marketing, is not less than eight and one-half cents per pound. Here is a very wide difference, with this point also to be emphasized, that in creamery butter you have a higher uniformity throughout, and wherever it is placed in competition with the average farm product, it invariably brings from five to six cents per pound more; so that you have the difference in the value of the product to place to the credit of the co-operative dairying, added to the difference in the cost of production, which varies from seven to ten cents per pound all round, — a great difference in favor of co-operative dairying.

There seems to be remarkable unanimity of opinion as to the value of skim milk for calf and pig feeding throughout the New England States. From all the data I have been able to gather, it would appear to be worth from twenty to twenty-five cents per hundred pounds, or two to two and one-half mills per pound. That added to the price of butter makes very nearly twenty-four cents a pound, which comes a little more than half way between twenty-two and one-half cents, quoted from New Hampshire creameries, and twenty-eight cents, which Mr. Bachelder was able to get for his product.

The success of co-operative effort depends entirely on the loyalty of the individual patron to the creamery. As we have heard from the reader of the paper, their success has been very largely due to the extent to which the principle of

co-operation was practiced by the patrons; that is, the extent to which this principle was observed in its spirit. And so it will be all the way throughout; the greater the influence they can exert on the individual patron, the more success will there be in producing a higher quality of butter than has been produced in the past. And I think one application of co-operation in the future will be the co-operative supply of a standard food, which will be prepared some day not far distant by the creamery. The average creamery is able to undertake the distribution of the food, and so control all of its patrons in feeding and caring for their cattle. They will come pretty closely on the heels of those wealthy private dairymen who have been able to produce the rich butter which sells at such gilt-edged prices in the markets of our great cities. At the Bay State fair I was very much struck by a statement of the cost of the creamery butter of New England. It seems that during the year last past at least one creamery in the New England States had sold its butter in New York for fifty cents a pound. But the very fact that creamery butter was good enough to sell for fifty cents, even twice or three times, shows that there are great possibilities of improvement in the production of creamery butter. Some reference was made by the reader of the paper to the insinuation that creamery butter will not keep. That is true of some creamery butter, as it is true, to a very much wider extent, of a large proportion of the average farm butter. The ordinary butter-maker, operating a small creamery, works under great disadvantages. He is very often selected because he presents himself for low wages; and he presents himself for low wages, in the great majority of cases, because he is not a competent butter-maker, and the butter he turns out will have very close correspondence to the rate of wages paid to him. So it will hold throughout. The expenses of a creamery must necessarily be ratable in proportion to the quantity of raw material handled. That is a law that holds good in all business, in all manufacturing operations; and the creamery is no exception to the general rule. There are some creameries in the West that are able to operate on as low expense as two cents and two and one-quarter per pound. These creameries manufacture butter at the

rate of two thousand and twenty-five hundred pounds per day. When the average yield of the cow of the New England States can be improved by that process of selection which is referred to by our friend, we may hope to see the products of each creamery largely augmented, and a corresponding reduction in the expense; and everyone who aids earnestly and faithfully in improving the status of the New England creamery around him, will aid in bringing about this improved condition of things, and will aid in increasing the returns from his own farming operations.

I was present at a dairy conference in Maine the week before last. I wish to say, in justice to some of the private dairymen in some parts of this State, that at the present time the creamery interest in the State of Maine is comparatively weak; that is to say, the creameries are small. If there is any difference up there, probably the private buttermakers will be making butter for a number of years at a slight advantage as to quality and price obtained for their butter, though I doubt very much whether the net results are any different between private and co-operative dairying. One of the speakers at the conference was a lady who had been practicing private dairying for a number of years, and she gave us a paper under the title, "How to make High-priced Butter." Last fall, and for a number of years past, she has been very successful in making butter, which has competed at all the leading fairs in the State, and, I believe, also at the New England Society's annual fair. She made an astounding statement. You have heard from Mr. Bachelder that he considers a cow yielding two hundred and twenty-five pounds of butter a very excellent animal, and she is; but I tell you, on the authority of a well-known public man in New England, that the average private production is one hundred and twenty-five to one hundred and thirty-five pounds per cow; and the same is true of Canada and northern Michigan, and some other dairy districts of the Western States. But this lady said she had got from six cows in her herd two thousand pounds of butter in the year 1887. It will not be more than eighteen hundred pounds this year. Now, these cattle are not fancy. They are pure-bred Jerseys, registered in the old Maine Register. They

are not eligible for registry with the American Jersey Cattle Club. So you see it is not a case of a fancy and wealthy farmer, for the lady in question is a widow, and has had to labor to bring up and educate a family. When I expressed my surprise at finding this very extraordinary herd up in the State of Maine, — where I should have least expected to find it, though it would not have surprised me in this State, or in Connecticut, — I was told by several men in the audience that two hundred and fifty and two hundred and seventy pounds of butter was a very common yield in private dairies. If that is so, it shows that Maine has attained a very high position in dairying, so far as cows are concerned.

Now, during a visit of a day or two last May in the county of Franklin in this State, I learned that there were a great many cows sending cream to the creamery at Conway, and many of them in private dairies, that stood up to two hundred and sixty and two hundred and eighty pounds per cow. The American Jersey Cattle Club consider that a three-hundred-pound butter cow is a splendid animal. It is possible for every farmer in this State, and in the State of Connecticut and in the State of Maine, to adopt that process of selection which has been presented to us in such a graphic manner by Mr. Bachelder. On the yield of the individual cow, and the expense of manipulating her products, the whole question of profit hinges. The closer we can narrow the margin, of course the larger will be the profit of the individual dairyman. There is no profit in keeping animals, or very little profit in keeping animals giving less than two hundred pounds of butter. The men who have distinguished themselves in making gilt-edged butter nowadays consider that an animal which is not good enough to sell in open market at auction for the price of two hundred and fifty to three hundred dollars is not good enough for their purposes. I can give you the names of several well-known breeders who make butter for the New York market at fifty to seventy cents a pound, according to their customer, whether sold wholesale at the hotels or sold through retail stores at a small rate of commission. These gentlemen are continually selling stock which does not come to their ideal of the standard cow; but they are always in the market to buy an animal

which in their estimation is worth from two hundred and fifty to four hundred or five hundred dollars. Every one in the audience can appreciate the fact that the cost of maintenance is no more for a good animal than it is for an average one, or, indeed, a poor one; so that the greater the aggregate product of the individual cow, the greater will be the profit on her, and the greater will be the profit derived from her products in the manipulation, whether in the private dairy or in the creamery.

I am exceedingly obliged to you for the attention with which you have listened to me, and I regret that I have not been able to present what I have had to say in a more connected form. I have trusted to the inspiration of the moment, and to such material as the speakers who have preceded me might offer; and I hope you will follow my example, and present some questions to the speakers who preceded me, so that we may have an interesting discussion on the paper we have had this morning. [Applause.]

The chairman then stated that the time had arrived for the next paper to be presented; but, before it was read, the secretary proposed the following, which was unanimously adopted: —

I move a vote of thanks to the town of Easthampton for the use of this beautiful hall; also to the Easthampton Farmers' Club and the citizens of the town, for the pains they have taken to make this meeting a pleasant one, and our stay agreeable; particularly for their very creditable exhibit of tools, manufactured articles and agricultural products, gathered in the hall below for our inspection.

Mr. Hickox. As I shall not be able to be present with you this afternoon, I have a resolution which I would like to offer, as follows: —

Resolved, By the State Board of Agriculture and farmers of Massachusetts, in convention assembled, that we earnestly and unitedly petition the Legislature to enact a law that shall protect both the producers and consumers of honest butter, and that a State Dairy Commissioner be appointed, with power and means for enforcing the laws relative to the same.

The resolution was greeted with applause and was adopted unanimously.

The Chairman. Our secretary, in making up his pro-

gramme, took into consideration the fact that the people who would come here are following different specialties. He has given us quite a number of short papers, which have been followed by pointed remarks and discussions. He also remembered that all the homes represented here have in them wives, and, perhaps, daughters; so he has arranged to have a lady read an essay before the Board for the first time in many years. It gives me great pleasure to introduce to you Mrs. George R. Chase of Medfield, Mass, who will speak to us about "Farmers' Wives and Daughters."

Mrs. Chase was greeted with hearty applause as she came forward to the platform. And, before reading her paper, she said: —

The invitation to read a paper at this time and place was a thorough surprise to me. I tried to think what qualifications I had for the work, and could count but three.

All my people, as far back as I have any record, have been farmers. It has been my great good fortune, especially of late years, to become acquainted with many Massachusetts farmers and farmers' wives. I have a sincere and deep love for the country and country life.

Standing here as I do to-day, I feel that I am, in some sense, a pioneer. If the path I hew be rude, much must be forgiven, because it is the first.

I ask you to believe that the people whom I present to you to illustrate certain points, are real women whom I know.

FARMERS' WIVES AND DAUGHTERS.

BY MRS. GEO. R. CHASE OF MEDFIELD.

Thankful and Desire, Mercy and Content, Dorothy and Priscilla, were farmers' wives. Brave, devoted, uncomplaining, their very names make us remember that first dreary winter spent on the coast of Massachusetts, — a winter dark with hardship, privation and danger; bright with woman's loving sacrifice, industry and hope.

A century and a half later, New England farmers' wives provided food and clothing for their little ones, tilled the farms and guarded the red-coated cows from the red-coated marauders, while their hero husbands were winning independence for them and for us.

The daughters of the mothers who had struggled with sickness, hunger, a savage foe, bore their full share of the joys and sorrows, the burdens and triumphs of 1776.

Then, as now, farmers' wives loved the home. "The first sure symptom of a mind in health, is rest of heart and pleasure felt at home." Every good home must have a good woman at its head. In the country she is the farmer's wife. To live in the country and enjoy all its pleasures, she must love the country. She must appreciate for twelve months the scenery which city visitors can have but for one.

To me, city born and country bred, to watch the bursting buds of spring, the growth of the green sward, the tossing seas of grain, the shifting shadows as they lift and drop over hill and valley, the matchless glory of the forest as it dons its autumn gown of red and gold; to listen to the hum of bee, the chirp of cricket, the first chant of frog, the snatch of bird song, the "gay gossip of the stream;" to smell the new-made hay, the healing breath of the pine; to pluck and taste fruit from my own vine and tree; to drive by water, meadow and wood; to stray through the fields, — these delight me.

"A voice of greeting from the wind was sent;
The mists enfolded me with soft white arms;
The birds did sing to lap me in content,
The rivers wove their charms;
And every little daisy in the grass
Did look up in my face and smile to see me pass."

"Who lives to nature never can be poor." Teach the children to love nature. Perhaps they will not need much instruction. Some little people who spend their summer in our town speak of it as "sweet Medfield." An older member of their household marveled at their fondness for their country home, until he began to explore it for himself; when nearly every day he could be seen riding on the most retired roads, — hard telling which of the three, rider, horse, or Irish setter, enjoyed these excursions most.

Two winter pictures I can never forget One, a sunrise from a snowy hill; far away stretched the glittering crust. to where the frozen river pretended to be asleep at base of other hill. The other came to me with a winter drive the

morning after an ice-storm. Exquisite the frost work on tree and bush and fence rail. The steel shoes of our sleigh creaked, and roadside weeds flashed their gems at us as we sped by. The sun climbed fast and high, in haste to undo all this beauty. I said that I would not take ten dollars for this picture. The same day a manufacturer said he would not take a thousand for his; but then he did not get his money from the farm.

The ideal home must be in the country. Steam heat and modern improvements are desirable, but not essential. To one once accustomed to them, country air, landscape diversified with hill and dale, meadow and singing stream, or silvery lake, have become a necessity. The house may be small; vines that climb and clamber, and not paint, may cover the weather-stained walls; the water may come from a bucket at the end of a sweep; but here, with no factory bell to vex, our home shall be planted and adorned with woman.

When a woman enters a farm-house to be its mistress, she ought, at least, to be qualified to take good care of the farmer and herself. For her own peace of mind she ought to know much about housekeeping; and, no matter how much she knows when she begins, she must learn constantly. It is the age of the cooking-school. Just now it is the fashion to dabble in dough; that makes it easy.

In preparing food for the well which shall keep them so, in ministering to the more delicate appetite of the sick, in combining a wise frugality with an ingenuity which varies the form and appearance of common kinds of food, there is ample scope for skill, affection, intelligence. The man is made in part by his stomach. The kind of man depends in no little measure on the quality of the food and its preparation. Morals and manners, as well as health and energy, depend on the food supply in no small degree.

The good wife will not, if she have daughters, do all the work herself. She will be too wisely kind for that. Rather will she lead and instruct them, allotting to each a special portion of work, which shall be done in such a way and at such times as never to be drudgery. Work not dragged throughout the entire day, but pushed in the early hours and regarded as a kind of healthy preparation for pleasure and

recreation sure to come, will be a feature of our home. Each daughter may be taught in turn to do any kind of housework tolerably, and some kind perfectly. To one may be given the dining-room. Let her see to it that the table is faultlessly arrayed, that bright silver, clear glass, snowy linen and fresh flowers entice family and guest. To another, the care of the chambers may be assigned. Haply she may have, or learn to have, the nice knack which transforms ordinary furniture and surroundings into restful hints of pleasant dreams.

The wife and daughters have a mission, too, in the parlor, which must be, not a room shut up, too dismal and lonely and dark for even a sensible fly to enjoy, but a light, cheery place, where, perhaps, curtains and carpets have been kissed so lovingly by the life-giver that they look less bright than once; where a bird may sing in its cage; where books and pictures look out upon one; where dog and cat may fear not to bask and purr before the blazing open fire. In short, in a room just bright and pleasant enough to be comfortable, but not grand enough to disturb or alarm lest harm should come to it, or primness be disturbed, our farmer's family may live. In such a home the wife may entertain those friends who favor her with their visits, and dispense an easy, natural hospitality, which is its own exceeding great reward, and which marks one of the differences between boarding-house and home, between happy husband and lonely bachelor.

Perchance the farmer who has gone with me so far agrees fully that his wife or daughter should be a power in kitchen and parlor, but shakes his head in doubt when I say that she may have a duty outdoors as well as within. I shall try to sustain the position that in many cases the four walls of her home shall not limit the horizon of her industry. Does she not know just what she wishes to have come from the vegetable garden? Why may she not provide vegetables and fruits for her table, as well as flowers? Let her select some specialty, and pursue it with loving interest, with woman's fidelity, until in her knowledge of this she shall not be excelled. What the specialty shall be, individual taste and surroundings must decide.

If small fruits be her choice, she may labor under a disadvantage in raising the crop; yet, in picking and packing the fruit she has no equal. A light touch and an exacting standard of excellence place her in the front rank. The berries which sell for the highest price in our market are packed by farmers' wives and daughters, and in many cases picked by them. If poultry be selected, then let her have no hens on the farm. Birds they must all be to her, and objects of faithful ministry, well nigh of affection.

One June morning the young wife of a farmer picked a crate of strawberries, then drove with him across the country to a social and literary meeting of farmers and their wives. None the less did she enjoy the good things there because she had earned them by taking care that work at home did not suffer in her absence. No less beautiful was she because cheek and hand wore a becoming brown.

A portion of each summer day is spent outdoors. Often the evening meal, spread beneath the trees, is a family picnic.

Young farmer, too shrewd to marry, how can you do without such a wife at this, — helpmeet, chum? Yet there are more to be had for the asking.

A Worcester County farmer's wife made sixty dollars net on pickled cucumbers. A Norfolk County farmer's daughter has cleared one hundred dollars from primroses. The writer has received seventy-five cents a box for strawberries, that did their best to win, and the praise bestowed on them was more satisfying than the cash they brought.

There is a field under glass in which we can work with pleasure and profit. Shy flowers, tomatoes, Black Hamburgs, out of season, may be had for the coaxing.

At a recent fair there was an exhibit of preserves and jellies which easily distanced all competitors. I was glad to notice, from the exhibitor's price list, that she was aware of the quality of her work, and charged accordingly.

The farmer's wife who is well to do may set a good example in thrift. Should only those do this who felt compelled to take the step, much of the force of example would be lost.

A man's business required him to drive through a manufacturing settlement in delivering straw to be sewed by

women into hats. He had never had occasion to stop, but drove to places on either side. One day he was much surprised to be hailed by the wife of the superintendent of the works, who told him that she wished to take straw to sew, and desired to be instructed in sewing it. "What a mercenary woman," thought the agent of the straw goods firm. Later, a very different impression was produced on him by her saying that while *she* did not need to sew straw, the wives of the workmen *did* need to, and she intended to learn the work and then teach them. What a noble woman this, in the changed light, her motive being known.

The work which once these wives of workingmen scorned to do, they now eagerly sought. They needed a leader, director, and could brook none but one of some position in society.

"I will work, and hope, and love,
Singing to the hours;
While the stars are bright above,
And below, the flowers."

The more familiar the farmer's wife becomes with the farm and its management, the more competent will she be to assume the management of it, should this ever be desirable or necessary. One woman whom I have met, during an entire winter, the first spent upon the new farm, milked the cows while her husband worked at his trade in the city. Another superintends the barn work, that the head of the family may be absent, working to meet the payments on the farm. In a third case an educated young lady has had given her to run her father's farm, he having turned his attention to other business. In another instance the father suddenly dies; the daughter, a bright young woman, assumes his place, and manages a nursery and fruit farm without detriment to the business or to her. Again, a farmer dies, leaving an excellent farm encumbered with debt. The widow manages the fifty acres, takes an active interest in raising registered stock, goes over her land herself, and is often followed by members of her herd, that testify to her gentle ways and kind treatment by the perfect confidence they repose in every one. This lady would like to sell her farm, but she will not sacrifice to the first indifferent buyer. She can wait.

Bear with me while I cite another case. Mrs. M's husband fell ill, lingered and died. There was a large family of young children living in an old house, which the husband had intended to replace by a new one. The lumber for this, ordered before his illness, was now upon the ground. Contrary to the advice and the dark predictions of friends and neighbors, this grand woman carried out her husband's plans, built the new house, and managed the farm, though as a part of her duty she felt compelled daily to drive her wagon of milk to town. This she continued to do, to the ever-increasing admiration of all, until her oldest son became her first assistant, strong and mature enough to relieve her. No jot or tittle of the lady was abated in this steadfast woman, who worked with both head and hand while it was necessary; who refused to sell the farm, as she was advised, and conquered grief and agony by toil for the living.

> "The path of sorrow, and that path alone,
> Leads to the land where sorrow is unknown."

Let no farmer's wife fail to maintain the dignity of her calling. It will do her no harm to remember occasionally that the mother and the wife of Washington lived upon estates in the country; that the wife of John Adams also lived on a farm.

There is a proverb which runs, "A man must ask his wife's leave to thrive." The farmer's wife should attune herself to sympathy with her husband's tastes, should become his loving comrade. Is he fond of horses? She will learn to be. Does he love to raise choice cattle? She will not try to thwart his ambition. Is he a dairy farmer? Then she will be glad to have his brand of butter rank high in the market and bear a good name.

No good woman can live for herself or for her home alone. In the church and in social circles her influence is needed. Her position will be just what she makes it. She should take a keen interest in the public schools; investigate their methods, their strength, their weakness. She should give to the teacher of her own or other children, interested and intelligent sympathy. If room be made for her, she can do good work on the board of trustees of the public library in

her town, or as member of an advisory board. If there be no public library or reading-room, why should she not organize one? Surely the kind of reading that is popular with the young concerns her.

I have, in the suggestions made to the farmer's wife, given her little time for idleness. She asks none. My acquaintance with Massachusetts farmers' wives is not a very narrow one, and I assure you that I cannot recall a single lazy woman among them. It is complimentary to them that I should fill their lives so full. They must be misers of their time

The mother must do much toward the education of her girls; but she cannot do everything; nor can all mothers do equally well. Many a daughter will outstrip her mother, to that mother's joy, not regret. Let the mother, however, try to keep pace, to bring back once bright school-days, and to brush the dust and cobwebs from matters nearly forgotten. Follow Bacon's famous direction. Pursue a course of reading with congenial associates. Join a company of people with the same tastes and employment as yours. Try writing out, in your own words, the information that has come to you by reading, then write your own ideas. Find whether writing maketh an exact man. Try conference with the same associates, and find whether it really maketh a ready man. We will not pass without considering Dean Swift's advice to talkers: —

> "Conversation is but carving:
> Give no more to every guest
> Than he's able to digest;
> Give him always of the prime,
> And but little at a time.
> Carve to all but just enough,
> Let them neither starve nor stuff;
> And, that you may have your due,
> Let your neighbors carve for you."

Encourage the daughters to tread the path of learning as long as they will. If any lag by the way too early, urge them on. "It is less painful to learn in youth than to be ignorant in age." Alice Freeman says: "Hardly a week passes that fathers and mothers and teachers do not ask me whether it will pay to send some bright, ambitious girl to

college. There is but one answer. If civilization pays, if education is not a mistake, if hearts and brains and souls are more than the dress they wear, then, by every interest dear to a Christian republic, by all the hope we have of building finer characters than former generations have produced, give the girls the widest and the highest and the deepest education we have dreamed of, and then regret that it is not better, broader and deeper." Then, too, they ought to have the chance to secure a special education. Why should not an education, practical in character, be provided by the State, for farmers' daughters as well as farmers' sons?

Let not our girls look down upon the simple, womanly tasks that bring joy and comfort to the household. When at home, where they are always welcome, let them play the part of hostess, and entertain the mother as they would their dearest friend. Let her live the day without a care. Perhaps it is her turn to have a vacation now; and, if you give her one, you will be repaid many-fold by speaking eye and happy face.

> "Be good, fair maid, and let who will be clever;
> Do noble deeds, not dream them all day long;
> And thus make life, death, and the vast forever,
> One glad, sweet song."

What, husband, ought you to do for the wife who does so much for you? Why, make the best of everything, of course. Don't fret, don't worry. Anybody can do that. The distinction will be in keeping an even keel in troubled waters. Remember that that wife of yours is human, usually more sensitive than you. Give her, without the asking, all the helps you can. Surely you will give her her fair share of the income from the farm? She will no doubt spend it wisely. What better diversion for her and you than to travel as extensively as time and means will permit? Travel near home. Learn the history and geography of your own town. Then go farther; explore as far beyond as possible. Money spent in this way will pay a dividend in information obtained, and pleasant recollections for after days in chimney corner and in field.

In selecting your meetings for social and intellectual im-

provement, go to those where your wife can accompany you. The places which do not need her can well spare you, or you can well spare them.

There is a disease that sometimes breaks out in country towns. It is known as "Western fever." Why go West? Isn't an Eastern cottage miles ahead of a Western dugout? What will you do when you get there, — raise crops for no market? Will you wait for that rise in the value of your land, which may never come? Is it to wrestle with malaria? Is it to count your neighbors and friends by ones instead of by hundreds? Is it to get along without those priceless privileges, thought all too lightly of here in New England, because everybody enjoys them? Would you miss scenery, good roads, society, churches, schools? It is to be hoped so. Oh, wife, when you are called upon to decide between New England comforts and Western possibilities, ask the dear man whether he proposes to go West for his own benefit, that of the neighborhood he leaves, or that of the country to which he is going.

Perhaps this may reach some who are so fortunate, or unfortunate, — for there are two ways of looking at it, — as to live in a house where help is not hired. They may have two handmaids, — Cheerfulness and Content. Cheerfulness has been called the daughter of Employment. Given a farm well stocked, well managed, plus a cheerful spirit on the part of some one member of the family, — sometimes wife, sometimes daughter, — and it will far distance another not so blessed. Everybody, from man to the animals, about the place, will catch the glad contagion. We love a dog, Ney, that, if he hears a merry laugh, if he be outside the room, immediately demands admittance. He thinks he must have his share of the fun, and he gets it. Charles Lamb used to say that a laugh is worth a thousand groans, in any state of the market.

Sometimes the girl or woman on the farm sees nothing to love in the life. She is dull to the beauty of her surroundings, and thinks she would gladly exchange her lot for a place in village or city. Such a farmer's daughter, while living on the farm, did not appreciate or enjoy her special privileges and advantages. Since leaving the farm she has

been teacher, member of school committee, and not without experience as a woman of affairs. Now she longs for land to till, and, having secured a liberal addition to the family garden, four o'clock on many a summer morning finds her busy with hoe or rake.

In parting with my farmer's wife I adjure her to cultivate the grace of contentment. Such a charm is this that no woman can afford to try to hold sway over the hearts of home without it. Look sometimes down instead of up the line. I remember a little poem called "Contentment," in which a widow and her son are represented "as having nothing, yet possessing all things." The hut, into which the rain enters and the snow drifts, contains a chair, a little three-legged stool, and a box spread with a clean white cloth and scant fare. The mother draws a furrowed hand across her boy's locks, and bids him go to bed, as he has warmed the toes enough, and the fire won't last. She has no blanket to wrap about him, but she covers him with boards that have been warmed by the fire. He turns towards her a smiling face, and asks, "Mother, what do the poor boys do that have no boards?"

"Some murmur when their sky is clear
  And wholly bright to view,
If one small speck of dark appear
  In their great heaven of blue.
And some with thankful love are filled
  If but one streak of light,
One ray of God's good mercy, gild
  The darkness of their night.

"In palaces are hearts that ask,
  In discontent and pride,
Why life is such a dreary task,
  And all good things denied.
And hearts in poorest huts admire
  How love has in their aid
(Love that not ever seems to tire)
  Such rich provision made. — Trench.

The Chairman. The subject is open for remarks, and I hope the ladies and gentlemen present will give it the consideration its importance deserves. Mr. Moses Humphrey, President of the New Hampshire State Board of Agriculture,

is present with us. He has had large experience in the agricultural department in New Hampshire, and as a farmer, and we will all be glad to hear from him, if he will speak to us at this time for a few minutes.

Mr. HUMPHREY. I do not know, Mr. Chairman, how long your few moments mean. If you want me to speak but five minutes, say so; or fifteen or half an hour.

The CHAIRMAN. We have an hour's time.

REMARKS OF MOSES HUMPHREY OF CONCORD, N. H.

Mr. President, Ladies and Gentlemen,—The subject that has been presented to us by our lady speaker is a subject of great interest to me. I want to say to you that more than fifty years ago I chose for a wife a farmer's daughter. I lived with her fifty-six years, and I tell you, if there is anything in the world that has made me, it is that woman. [Applause.] I tell you, if you have not looked that ground over fairly and squarely, you do not know how much the influence of a wife is over a man; no matter what position he holds, whether in the government or as a farmer, or in any other business. I married a farmer's daughter, and that is the kind for the young and old to get wherever they go. If you want to succeed in life, you want to get practical common sense. If you find men or women that have risen to eminence in any part of the country, you will find that they have come from the farm, where the habits of industry are taught the boy and girl from youth up. The habit of industry is everything to a man, anywhere and everywhere; and, if you bring your boys and girls up to such habits, they do not have much fol-de-rol or nonsense about them; they are looking forward for business. You have got to start with a good foundation to make the right men and women for the country. Look all over this country and see who controls it. Where did they come from? Who were they? To a large extent our leading men were farmers' boys, their mothers were farmers' wives; and, if you trace their ancestry, you will find that a large portion of them came from New England, and my experience proves that you will trace them back to a New England farm.

Who is Tom Eastman of New York? I knew Tom Eastman on a farm; he worked as hard as any boy; he is a good, thorough-going fellow, and he had a splendid mother to teach him. He was brought up on the farm, and when he left the town he went to Cleveland, Ohio, and started a milk farm. Then he went to buying cattle, and from that he shipped his cattle to New York; and he was the first man that ever fitted a ship to carry beef to England. That man to-day is worth six millions of dollars. Now, I knew him well all the way through, and I wanted to say in this connection that he married a farmer's daughter, and she was one of the best girls that I ever knew. She knows how to make butter, and can make butter to-day as well as any lady present. Now she can control her household in New York, and is not filled with a desire to make a fine show. She makes a happy home, and everybody happy about her. This is one farmer's daughter that I know.

Now let me speak of another man, — Austin Corbin. I knew him as a boy, and lived beside him. I was older than he. He started out and worked as hard as any other man until he was twenty years old; then he got a little education and was admitted to the bar, and went out West; there he had a taste for banking, and he went into that business; and to-day he is a millionaire, — I do not know how many millions he has. He is a practical sort of fellow; if you come across him you will find he is the same Austin Corbin to-day, with his millions, that he was when a boy. That is my experience with him.

Now, there is another question connected with this matter. It is a broad question; I could talk upon it a great while. What are we living for? Of course we all know we cannot stay here. Our object should be to get the most good out of life we can; get it honestly, get it fairly, get it squarely A man that does not get his money honestly and fairly and squarely does not enjoy life. That is my opinion, and I have seen a good deal of life. I want to say one word further in connection with Mr. Eastman of New York. There was another young man by the name of Brown. They both started life together. Both taught a little village school; and, when Eastman went West, Brown stayed upon

his farm and did not accumulate much wealth. They met a few years ago, and Eastman said to him, "Ed., if you had gone out with me, you would have been well off by this time." "Well," said Brown, "let us see, Tom, how it is with you. You are out there with your millions. I want to know whether you get more out of life than I do? I have a farm here; I have brought up a family of children who are well-to-do in society, and my farm is all paid for; I have all the comforts of life, and do not have half as much trouble as you do. Do you get any more out of life than I do?" "Well," said Eastman, "I do not know. It is rather pleasant to have plenty of money to do with." The next year he met Brown, and said, "I have come to your conclusion, that you get the most out of life." Now, that is the point, to get the most out of life. You may go ahead and acquire wealth, and you may reach a certain point, no matter where it is. Perhaps when you started in life you thought if you got a few thousand dollars you would be satisfied; but you are never satisfied with that; and I want to say if there are any young men here, do not think that when you get up to a certain sum of money you will retire from business, because you will not do it; if you do you will die, — you will not live two years afterwards.

I want to say to you I have been in active business sixty years, most of the time in farming, and now I am fool enough to run a horse-railroad. I would not be idle for any amount of money. I want to be doing something, and when I die, I want to die with the harness on. I want to feel that I have been worth something to this world. [Applause.] I have never cared to amass wealth; I want only enough to live on. I have enough to get through with, and if I have a dollar or two left I am going to give it to some charitable institution. I mean to get the most out of this life by going along squarely and dealing justly. I want to leave a good name behind me. That I would rather have than any monument. [Applause.]

I am not talking agriculture. I do not suppose you expected I would. I have been connected with our Board since its organization, eighteen years, and have just been appointed for another three years' term. I calculate to live

to serve many more years. But I must close. Let me say once more that farmers' wives and farmers' daughters make happy homes. There is no man that ever enjoyed a home more than I have, and therefore I can speak from my own experience. You may think I am telling a story; but I am eighty-one years old. [Applause.]

The CHAIRMAN. The remarks of our friend certainly have a good ring to them. He is a young man, as you can see and understand by his talk. I do not see anything to hinder his living eighty-one years longer.

Mr. HUMPHREY. That is what I started for. I feel just as well as I did when I was a boy. You know sometimes we think these old fellows are old fools, and I do not know but you think I am one. Still, I think my head is level enough to run a horse-railroad and make money out of it.

The CHAIRMAN. I hope he will make money out of it, for he has told us he is going to give it to charitable institutions when he gets through.

The CHAIRMAN then called upon Mr. JAMES DRAPER of Worcester, late Acting Master of the National Grange, to address the meeting.

REMARKS OF JAMES DRAPER.

I will take only a moment of your time, but there are two items in this programme that have moved me. The first is, that you have invited to grace this platform a woman to speak to you upon this touching subject of farmers' wives and daughters. The other is just this line on the closing page, "The subjects for discussion on the last day are of particular interest to Patrons of Husbandry, and they are invited to be present, and take an active part in the discussions." Now, Mr. Secretary, as representing the Order of the Patrons of Husbandry for fourteen years in Massachusetts, I thank you for this invitation to be present and participate in your discussions. I expect a better and higher development of the agricultural interests of Massachusetts from this union of efforts.

Now, a word or two in regard to this organization. I am keenly aware that many of you, through ignorance, perhaps,

may be somewhat prejudiced against it; but, let me say to you, we are all working for the same grand end, — to improve the farmer, to improve the farmers' homes, and, through education and co-operation, to improve the farming industry of this Commonwealth; and not only of this Commonwealth, but of the nation. Twenty-two or three years ago, at the close of the civil war, Mr. Newton was Commissioner of Agriculture. His thought was upon that part of the South where the devastating influence of war had swept away all the prosperity of the former agriculture. He appointed a Mr. Kelly, then a clerk in the department of agriculture, to visit the South. He went through that country, and saw the desolation on every hand. What could be done to encourage the disheartened and discouraged agriculturists? He put his mind to the work, came back to Washington, met with those who had been interested in agricultural matters, and suggested to them the idea that, first of all, they must educate the people of the South. They could not plant agricultural colleges there, but they could gather the people together in some local associations, and educate them in improved methods of agriculture, — in a reconstructed agriculture, as it were; because the slave labor of the past must be replaced by the paid labor of the freedman. How could they educate them? They must have some organization to do this, — a thorough one, State and local; and, looking upon the history of associated efforts in years gone by, they conceived the idea of binding this people together in a fraternal order, with a ritual. And, when they were speaking of the South, the question was asked, "Why confine it to the South? Why not make it national in its scope?" And so they went on enlarging their ideas, until they perfected a national order, — a strong fraternal body, bound together with a ritual, whose whole object should be to improve and benefit the tillers of the soil of America. In that early day there was much to be overcome; but they were determined to carry forward their work, and the State organization began, slowly working its way to the westward, and this order increased with a rapidity second to no other in the world. But they made a mistake. The politicians and sharpers thought there was an opportunity to run it

as a political and money-making machine, and it had to go through a purging process; and from this time on the work has gone forward on a sure basis. What is the secret of our strength? First, a strong fraternity. The history of the world tells us that the fraternal orders have stood next to the Church of God. They are one of the safeguards of this country, and so we have bound ourselves together with certain rites and ceremonies.

In its very inception the question was raised, What about the farmers' wives and daughters? And a Mrs. Carrie Hall, then in Washington filling a clerkship in one of the departments, suggested, "If you are going to admit the ladies, why not admit them on an equality with men?" The idea was adopted at once, and it was decided that women should be admitted in this order on an equality with the men, entitled to every position that men are entitled to, being admitted to the councils, and helping carry on the work in all ways. And to women to-day we owe the stability and purifying influence of our order.

Our work is not familiar to all of you. I see many familiar faces, and we feel that it should be better known. It must occur to you, that, to bring about results, there must be thorough organization. You are doing a noble work, members of the State Board, in your meetings once or twice a year. You are doing a good work in your institutes, but there is nothing to bind you together in strong effort for aggressive work. We may have, perhaps, one hundred subordinate granges in Massachusetts. We are required by our laws to hold monthly meetings, but some of the granges meet bi-monthly, many weekly; and we place our five thousand meetings held annually in the hill towns of Massachusetts against your few field meetings. Hence, when the time comes for us to work, we work understandingly and unitedly, and determined to win. Here is an illustration. A question came up in the United States Congress on the oleomargarine law. We heard of it here in New England, and the masters of the State granges of New England assembled in Boston and discussed the matter. We decided that we would send a communication to Washington that would mean what it said; and, in the name of forty

thousand organized farmers of New England, we demanded the passage of that bill. That meant something. If we had sent it in the name of A, B, C and D, it would have passed away; but when we spoke of forty thousand organized farmers of New England, they thought it was time to listen. I might speak further of the work of this organization in shaping national legislation as well as State, but I will not take up your time. I do, however, wish to say to you, Mr. Secretary, that we appreciate this innovation in your work in giving us an opportunity to be heard, and assure you that the State Grange of Massachusetts will ever be ready to co-operate with you in every measure that shall help to purify the politics of our State, that shall help to establish temperance in our homes, and that shall help to build up and foster Massachusetts agriculture. [Applause.]

The CHAIRMAN. Our essayist will be glad to answer any questions which you may wish to put to her on the subject-matter of the essay.

Mr. MYRICK. I should like to ask how she solves the hired-help question in the house?

Mrs. CHASE. I have never had any.

Mr. MYRICK. Well, Mr. Secretary and Mr. Chairman, let me say that if every farmer was fixed the way Brother Chase is, we should hear no complaint about farming not paying.

The CHAIRMAN then invited any of the ladies present to make remarks upon the topic before the meeting; but, none responding, he called upon Mr. H. A. BARTON, Jr., of Dalton, Master of the Massachusetts State Grange, to address the meeting.

REMARKS OF H. A. BARTON, JR.

Mr. Chairman, Ladies and Gentlemen, — It is a pleasure to me to say a word or two here this morning, in connection with the subject which has been so ably and so practically placed before us in the address to which we have listened with so much interest. As has been stated to you by the Chairman of the meeting, within the past few days I have pursued the duties of Master of the State Grange of Massachusetts, and I hardly saw how I could spare the time to

attend this meeting; but, as I looked at the programme and saw that your Secretary had arranged for the Patrons of Husbandry to be represented here, I felt I must at least try to meet you; and I wish also to thank him, and the members of the State Board of Agriculture, for opening the way, as they have here to-day, and for inviting our co-operation in working for our farmers. Let us farmers try to have this spirit; let us try to see to it, that, as farmers, in the Grange, in the State Board of Agriculture, and in our State Agricultural College and Experiment Station, we do all that we can to unite our efforts, and work solidly together to build up and assist the agricultural part of our State. As we look over our State to-day, we see thousands of acres upon which there is not a hoof of cattle or sheep. These are subjects which come before us for our consideration, and which we should try earnestly to meet.

In regard to the subject which has been so ably presented to us here, I also take an earnest interest; for the success which has attended the efforts that have been made to educate the farmers throughout the country, is due to the mothers and daughters with whom we have been associated. The influence which has gone out from those homes, and their influence in our meetings, has tended to refine and elevate them, and raise their homes to a standard which we would never have equalled had it not been for their influence and their associations at those meetings. I will not weary you with further remarks at this time, because there are sisters here whom we would wish to hear, as well as some men whom we would like to hear from upon this subject. While the paper was being read, which was so interesting to me, there came to my mind a few lines I read in a paper the other day, and I will try to repeat them; but, before doing so, I will say that as agriculturists we cannot expect to be millionnaires. We must be satisfied with a moderate income, and must try to enjoy the pleasures of our home life, must try to make our homes pleasant, and make the best of what God has given us to use.

"Give me that home where kindness seeks
To make that sweet which seemeth small;
Where every lip in fondness speaks,
And every mind hath care for all.

Whose inmates dwell in glad exchange
Of wishes free from vain expense;
Whose wants beyond their means ne'er range,
Nor wise denials give offense."

The CHAIRMAN. I see in front of me Mr. BENJAMIN P. WARE of Marblehead, a member of the State Board. I think the members have not had much to say in regard to farmers' wives and their homes, and I hope he will speak for the Board.

REMARKS OF B. P. WARE.

Mr. Chairman, Ladies and Gentlemen, and Fellow Farmers,—I did not expect to be called upon on this occasion, although I have been connected with the Order of Patrons from almost its beginning in this State, and have been associated with them, with my most hearty interest, all of this time. I am in full sympathy with what has been said here to-day, and I am delighted that there has been presented to you a specimen of the result of the work of the Grange. That lady who has presented to you such an able essay, you, I dare say, would never have heard from, were it not for the influence of the Grange. She has shown to you what you may reasonably expect in selecting the daughter of a farmer's wife for a wife for yourself. She has pictured to you a being that perhaps some of you, my young friends, may feel that there is danger of taking to herself wings and flying away; but do not have any such fear, for, if you anticipate the pleasure of heaven hereafter, if you would have a taste of it here on earth, take to yourselves one of those beings that have been so ably described here; and in no other way, in my opinion, will you come so near enjoying on earth the pleasures of heaven.

I believe in the great influence that this State Board of Agriculture has exerted upon the farmers of Massachusetts in the line of agriculture. I believe in the great influence for the agriculturist that comes through farmers' clubs and farmers' institutes. They are all doing a great and good work; but there is no organization of agriculturists that does the complete work for the farmer, the farmer's wife, the farmer's daughter and the farmer's son, that the Grange is doing, has done and ever will do, if it continues true to the

principles under which it was first established. It has been said here that next to the Church of God there is no influence equal to that of the Grange. That is true in my opinion. I believe that the Grange makes the practical application of Christian principles. I was glad to hear my friend on the right say that this life was for us to get what we could out of it; not to see how much money we can make, but to see how much good we can do, not to ourselves alone, but to our neighbors; and if we do good to our neighbors, we shall certainly do good to ourselves, and in that way we are getting the most out of this life. But we cannot get the most out of this life as farmers, unless we become Patrons of Husbandry. I speak from actual knowledge. But this is not the time to make a canvass for the growth of our Order, — that is not what we are here for; but it is no harm to show you what good may come from the Grange in connection with other agricultural institutions for the benefit of the farmer and farmer's family. I am glad, sir, that you thought of the Grange, and gave opportunity for a word being said in its favor, because it gives us an opportunity to bring to the front our wives and daughters and sisters. I do not know but all of us farmers had a true and full appreciation of the importance and value of the women in the farmer's establishment; but to-day it has been depicted in such living and vivid colors that we must go home with a renewed love for our own wives and daughters, if it is possible to increase it.

Recess until one o'clock.

Afternoon Session.

The meeting was called to order at 1.45, when the Chairman introduced Mr. J. M. Hubbard of Middletown, Conn., who read the following paper, upon "The Uses of Association by and among Agriculturists." Before beginning to read his paper, however, Mr. Hubbard said: —

Mr. Chairman, Ladies and Gentlemen, — Before I proceed to read the paper which I have prepared for this occasion, I desire to say one or two earnest words in appreciation of the essay which concluded the morning's exercises. All

of you appreciated it. No one could listen to it without appreciating it. Its truths were timely and wise, and the form and manner of its presentation were so finished and perfect that it sent those truths home to our hearts, and I am sure that good will come from it. Its thought ran somewhat in the same lines of my own in preparing this paper, so that it serves in some measure as an introduction to what I have to say, and I am glad of it for that reason; but, on another account, it places in strong contrast the comparative rudeness and imperfection of my own work. I trust, however, you will pardon me. I am glad that, if the audience of this morning had to make their selection between Mrs. CHASE'S essay and my own, they chose hers, for they chose wisely in so doing.

THE USES OF ASSOCIATION BY AND AMONG AGRICULTURISTS.

BY J. M. HUBBARD OF MIDDLETOWN, CONN.

Association is a means to an end. It does not create force, but it concentrates, directs and makes effective the force which would otherwise be wasted. It is to individual power what the enclosing walls and directing machinery of the boiler and engine are to the expansive force of a single drop of water converted into steam.

Gathering many drops together, holding them firmly, directing their force wisely, great and good works are accomplished. Left without concentration and control, the same force is dissipated and lost.

The importance of this principle must have commanded recognition at a very early period in the history of the human race. Indeed, such recognition seems to have been instinctive. Not only is there no record on parchment or monument which hints of a time when association among men for the security of life and of its desirable possessions was not practiced, but among the lower forms of life as well, there seems a clear perception of the benefits of association. Birds flock together for their long migrations, wolves hunt in packs, and the grazing animals roam in herds for society and mutual protection.

But, while association is a recognized necessity of rude conditions and low forms of life, it is not characteristic of

them. On the contrary, it becomes more pronounced and pervasive as life climbs upward to higher forms and more affluent conditions. For, while life is wonderfully flexible, adapting itself to its surroundings with great facility, and while the heirs of the ages are the richer because of what past generations have accumulated for them, still the essence of life remains the same under all conditions and through all mutations.

Life is a battle-field; and, while civilization has modified the conditions of strife and changed somewhat its arena, the fact of strife remains. The universal reign of peace is still the dream of the enthusiast, visible only in the dim future, an uncertain prospect; and, I may add, a doubtful good.

It could not have taken the most sluggish intellect long to perceive that in this strife the one who stood alone was doomed to defeat and early extinction. Two are stronger than one; many are more powerful than few; and, in a combination for defense, what each does for all the rest, he does for himself as well. And, following very closely in the footsteps of this idea of personal security through association, there must have come the idea of territorial security. So long as antagonistic groups of men claimed the same territory, security could be maintained only by constant readiness to fight. But, if each such group occupied its own ground, with defined limits and a conceded right, peace between them might be maintained so long as these territorial rights were regarded. Upon these two closely related ideas of personal security and territorial integrity, established and maintained through association, the wonderfully varied and complex structure of human government has been built. These are the strong foundations which bear up this all-comprehending, involuntary association, which the rudest forms of social life cannot do without, but which finds its widest scope and shows its best type where civilization is most advanced. Until human government was established, life could have been but little more than mere existence. But, where a degree of security had been established which would permit the growth of the arts of peace, and life began to take on breadth and variety, other associations became necessary for the development and expression of the fuller life. And

I think that among the earliest of these must have come religious associations.

However much we may differ in our theology, no serious-minded person can ignore or belittle the religious element in human nature. The associations of men in which this element has been the controlling one stand second only to governmental associations in the influence they have exercised over human life and action. I here make mention simply of the fact, reserving comment until a later period.

History informs us, that, as life became specialized and skill developed, as manufactures grew and commerce arose, and men united in the same governmental and religious associations separated into groups, according to their several avocations, the common interests and mutual antagonisms inseparable from such a condition of things called into existence a group of associations, each designed to protect the interests of an industrial class. The guilds, so prominent and useful in Europe a few centuries since, are examples of associations of this nature, and, with those already mentioned, give us historic illustrations of the three groups into which nearly all associations of men may be gathered. They are those which relate to government, those in which the religious or benevolent element is the controlling one, and those which stand for the interest of a group or class. Leaving out of view for the present the associations peculiar to the present age, I wish to ask your attention to a few characteristics of those which are historical.

Note this first. All associations which meet a permanent need, and so endure from generation to generation, take on organization. They become bodies. A directing head crowns them; a pulsating heart beats within them, and keeps the life-current in circulation. They rush out with arms, and grasp with hands; and we can in no way so well describe their function and action as to use the terms of life and the bodily organism. Now, to meet a common danger, men might temporarily associate themselves, to separate as soon as the danger had been averted. But, finding soon that danger is a constant attendant of life, they learn to make their association permanent by organization. They gain not only

permanence in this way, but effectiveness as well. Association accumulates power, but organization provides for its wise expenditure.

Note, secondly, that all these associations, while formed for good uses, may be and have been turned aside to those which are evil. Human governments have expended their force in tyranny over their own, and violence to other people, which no principle of right can sanction or excuse. Religious associations have shown a peculiar susceptibility to fall under the dominion of hate, rather than love; and the record of their misdeeds is long and black. And the voluntary associations, formed for the guardianship of important interests, have not kept their record clear from well-founded charges of perversion of power to others' injury. It is so easy to pass from defence of one's own rights to assault upon the rights of others; so difficult to halt the movement at the true line of demarkation, and restrain the eager impulse of human nature to push its advantage to the utmost. The sense of power is an exhilaration to him who wields it; and history shows on many of her pages how easily this exhilaration passes to the delirium of intoxication.

Note, next, that after frank and full statement of all the evils wrought by the misdirection of the power of association, an immense balance of good still remains to its credit.

It is either the fault or misfortune of history that it occupies itself so largely with the strifes of nations and individuals. The picture which it paints becomes in this way distorted. It puts the drama of war upon the stage in full cast and with all the accessories, while peaceful, happy home life is something between the acts. "Happy," says the old proverb, "that nation whose history is brief." Meaning, Happy that nation the story of whose strifes is brief. But, if it were possible to put on record the story of myriads of useful individual lives, of unnumbered happy family groups, of neighborhoods, of states and nations in peaceful activity, made possible all of them by the association of men in governmental organizations, the showing of history would be a very different one. The anarchists who would cure the incidental evils of government by the destruction of its entire fabric, are either under a horrible delusion or are malignant

enemies of their kind. And not less mistaken are those who war upon religious associations because of the bigotry and tyranny which these have so often manifested.

The work of these associations, in elevating and purifying thought and conduct, and in sustaining humanity under sore trials by means of faith in a loving Heavenly Father and in a spiritual life supplementing this mortal life, will a thousand times outweigh the evils they have wrought, stated at their utmost.

And I think the same thing is true in general of the miscellaneous class associations, which we are, perhaps, too apt to think of as selfish and narrow, and not calculated to do good work. In the order of progress, narrowness precedes breadth; and, if an organization be not in its influence narrowing, it is no valid criticism of it to say that it is narrow. It is its tendency, not its absolute condition, by which it must be justified or condemned. We learn the grand lesson of brotherhood little by little. We can find room in our hearts at first for but few, and those must be in some way very close to us. It is the exercise of brotherliness which opens our eyes and warms our hearts and widens our scope of fraternal feeling. Any association which gives brotherly love a chance to work, even in a limited sphere, is doing good.

And, while the word selfish, as we use it, has a bad sound, we must remember that a true regard for self is not only not bad, but it is one of the first and most important duties laid upon any one. To provide for one's self; within reasonable limits to assert one's self; to find one's place and to occupy it, if need be to crowd an intruder out of it; to grasp the equipment necessary for his work,—all these have reference to self, and may perhaps be classed as selfish actions. But they are right, every one of them; and he who fails therein is responsible for a blunder, if not guilty of a wrong. It is no objection to an association that a true self-regard and a justifiable self-interest are among the objects it seeks to promote.

I believe that the final verdict upon the work of all these associations must be this,—They have wrought well. Governments, churches, trade associations, and most of the mis-

cellaneous benevolent and social organizations, seem to me essential parts of the machinery of progress. Life is uplifted and enlarged by their agency. Never in the world's history have they been so numerous, so active and so powerful as now. Every sign of the times points to their continuance and increase; and those who would do their part of the world's work need to use the most effective machinery in existence.

I wish now to notice another very general characteristic of these associations. They all do, with more or less efficiency, the work for which they are designed, but they do not stop with that. They do other work; and this unplanned and unforeseen outcome of their action is sometimes of greater importance than any other. In general, it may be said that men form associations to expend their force outside themselves, upon some resisting body or against some opposing force. But the disciplining force of association commences instantly to work upon its own members, and this work is never for one moment intermitted. Without intention, almost without consciousness, men in association with each other are being wrought upon by a transforming force, which produces such change that we can hardly imagine what sort of creature an isolated human being would be. Of one thing we may be sure, — he would be immeasurably inferior to the associated man. This indirect, unplanned, almost unnoticed, work of association, is not only great, but good as well. The ideal man is never the one who stands alone, but always he who stands in the ranks of the great army of humanity, battling there for dominion over the forces of nature, and for conquest over the powers of evil. It would hardly be in common humanity to subject itself to this disciplining force, but for the need to use the power of association in external relations. Here, as in many other matters, those who work for good ends accomplish other and better things than those which came into their plan. Those who build well, build always better than they know.

In the campaign of life there are truces and treaties, but never such a lasting peace as will permit us to lay our armor down and disband our forces. We would gladly do so, if we might. We hate to be always on guard; we thoroughly

dislike drill and discipline; and we heartily wish that things were so ordered that we might have what we want without fighting for it. But the world is not framed and managed to suit our wishes in this respect. We need not join in the apotheosis of strength. We know that might does not make right, and yet we must recognize the truth, that there are rights which belong to strength and do not belong to weakness.

There is a foundation in justice for that seemingly harsh law, that "unto everyone that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath." Neither individual man or classes of men have any title to opportunities and privileges which they have not proved their ability to hold and use. If left in unworthy or incapable hands, a wrong is done not only to those who could and would use what they but listlessly hold, but also to the great interests of humanity, for which all powers are to be used and all privileges exercised. The law of the "survival of the fittest," harsh as some of its operations may seem, is not inconsistent with the law of love. Both spring from the same Divine Source, and love can find scope to work only as power is lodged in fit and capable hands.

Suppose for a moment that the resources of the world were lodged permanently in incompetent hands. Suppose that this continent had been left to the Indians, as some sentimentalists would seem to think should have been done. Suppose that everywhere incapacity had been allowed to hold the key to earth's resources, refusing or neglecting to perform for humanity the service of unlocking these resources, and preventing others, able, ready and willing, from rendering this service The wrong, the evil, the shame of such a situation would have cried from earth to heaven, and compelled a change. Limitations are defined by opposing forces, reaching at length a condition of equilibrium. This is true when nature is inanimate and force is blind; true also of all forms of life and consciousness; true of nations and true of smaller groups; true of individuals. Room to grow and scope to work belong to those who can fill the room and do the work. The prizes of life, in all its walks — in business, in literature, in science, in oratory — belong to those who,

by virtue of superior ability, can take them; and who, in taking them, wrest them away from the weaker contestant, as really as victory is wrested from the weaker side in battle. The silver-tongued orator who declaims against war and pleads for universal peace, is victor on a field of strife as truly as is the soldier whom he denounces.

It is right that this should be so. By this method of selection humanity is served in the most important matters by those best fitted for such service. We know no other way to single out these servants and give their work into their hands. And it is only when these questions of supremacy are settled that we come to an abiding peace. Our own late civil war furnishes a most striking illustration of the way to peace through strife. Only those who participated in it, or lived through those awful years in vital sympathetic connection with it, can form any conception of its horrors. But we could not avoid it, — we could not escape it. That is what we say who were on the side which won; and those who were on the side which lost say the same thing. Our great commander's invocation, "Let us have peace," could be uttered and answered after that tremendous struggle had been fought out to the bitter end. But its results will justify it. All its cost is to be repaid many times over, not alone to those who won, but to those who lost, as well.

I am now to apply these general considerations to the questions raised by the theme assigned me. How does the farmer stand related to this principle of associated life and work? Should he make use of it, or no? If yes, to what extent, under what limitations, through what forms, and by what rules?

To the first question, an affirmative answer must be given. I anticipate no dissent in this matter. The farmer cannot neglect an agency capable of producing results of such importance to himself and to the great interests committed to his charge. Just think of it a moment. Agriculture is the mother of all industries; and, although the children to whom she has given birth and nurture have grown to vigorous maturity, the mother-industry still equals in importance all others put together. In this country, agriculture gives employment to half the population; and here, as elsewhere, the work she

does is the essential work. What seem to some the hard conditions of the farmer's life, may drive you and me out of it into something which offers greater attractions; but, if we desert, our places must be filled by new recruits. The farming class must continue, and it is of the highest importance that its work be well done. It holds, as no other class does, the welfare of the whole community in its hands. It should be equipped for good work. All the powers and privileges which it can rightly use, all the attractions and compensations to which it is fairly entitled, it should demand and receive.

Agriculture is more than a business. It is a life. Men employed in other avocations can make the separation between their business and their life very nearly complete. They can go home and leave their business behind them. Not so the farmer. His home must be with his business. His business must come into his home, and those who share his home must also be his partners in business, if it is to be successful. This fact must be taken note of in framing associations for his especial use. They must be so framed as not only to promote his business prosperity, but also to contribute to the fulness and satisfaction of home life for him and his.

What should be the relation of the farmer to the government under which he lives? His membership in this great association is not a matter of choice with him. He comes into it, as do its other members, by the avenue of birth, and he can withdraw only through the solemn portals of death. While he lives he is a member; and the query is, What does this membership mean to him, and how should he use it?

I venture to use here, for purpose of illustration, a recent incident in my own experience. At a reunion last spring of the Army and Navy Club of Connecticut, there was devolved upon me the pleasant duty of responding to this sentiment, "The Farmer Soldier." The tone of the meeting had been light and joyous; but this theme took such possession of me that I could not treat it lightly. So far as my own observation went, so far as other sources of information supplemented it, our army in the late war was very largely an army of farmers. I believe this to be true of patriotic

and defensive armies everywhere and at all times. They come from the nation's farms. For the nation's life they offer, and if need be, sacrifice their own. Their work done, the survivors go back to their silent, inconspicuous lives, and are too soon forgotten. Seeking for the philosophy of this fact, it seems to me that the common phrase, "The land we love," does have a special weight of meaning for the class who own the land, live upon it, work upon it, study it, develop its resources, and from those resources feed and clothe the world. If there be something in this thought, and the farmer does indeed have especial reason to love his country, to stand for its defence in time of danger, and to die for it if need be, it would seem to follow that he ought to exercise the full measure of control which belongs to him and the government of that country. I most thoroughly believe that to do this is his privilege and his duty as well. In this land of freedom, where the conduct of government is committed to the people, such control must be exercised largely through the agency of political parties. These great, loosely organized, voluntary associations of voters, of which but two worthy of the name can co-exist, should represent the progressive and conservative tendencies of the public thought. I do not believe in a farmers' party. There is no room for it, and class interest is far too narrow a basis for such an association. The farmer may belong to either the progressives or conservatives; but, in the party of which he is a member, he should be a force. He should meet therein the representatives of every class interest upon equal terms, and exercise that measure of control to which the number and importance of his class entitle him.

There are two general principles or methods of controlling the action of a political party. One is to guide it aright through forethought and influence exerted at the right moment, as the skilful horseman guides his team by constant touch of rein. The other method attempts no guidance, but visits each departure from what is deemed the right course with crippling punishment. While this last method may sometimes prove effective, it has no other recommendation. Important public interests are endangered by it, and at best it is cruel and unskilful.

It is a commendable thing to vote aright; or, with ample measure of caution, not to vote wrong. But the act of voting is a choice of alternatives; and it is a matter of the highest importance that the issues upon which one is to vote be formed aright. The farmer should do his full part, not only in contributing by his vote to the success of the party of his choice at the polls, but also in the more important work of influencing the course which his party shall take, and determining the attitude which it shall assume with reference to great questions of public policy. I think we may go farther than this, and of right may, and in duty ought, to insist upon reasonable and just recognition in the distribution of the honors and emoluments of public station.

The most effective administration of the business of government may require that in a great number of positions, whose occupants are strictly employees, and whose duties are ministerial or mechanical, skill and experience in the performance of these duties shall be prime qualifications; and, so far, an office-holding class may be recognized. But, so far as those positions are concerned which really direct the policy of the government, no office-holding class can be tolerated in a government "of the people, for the people, by the people." And no great class of citizens can be refused a reasonable recognition in the distribution of these positions, without wrong to itself and injury to the interests it is set to guard. No such class has any business to submit to this exclusion. Without question, it is the privilege not only, but the duty as well, of the farmers, to use the power which their numbers give to secure for themselves recognition in public station, as well as to give right direction to public policy. I rejoice to see, in the formation of local political clubs of a permanent character, a movement toward a more orderly and responsible direction of party action. Through the machinery of these clubs, where they exist, and through such other agencies as may be available, I urge farmers to take that share in the direction of public affairs to which their numbers and importance entitle them.

How shall I treat the relation of the farmer to religious associations? I do not stand upon this platform to preach to you. I do not wish to impose my theology upon any one,

or to proselyte any one to my church. I have spoken of religious associations, not for the sake of thrusting upon you a subject which does not belong to this discussion, but because I could not leave it out without marring my theme. Religion cannot be kept out of life without crippling and degrading life. Its expression may be almost infinitely varied, and its philosophy subject to great changes; but the religious element in man's nature remains steadfast through all variations, and requires association for its right expression and healthy development. I certainly could not advise any farmer to strangle or starve the religious element in his nature. I believe in churches and the public worship of Almighty God. I believe in the religious observance of the Sabbath day. No class in the community needs its rest in all fulness more than does the farming class; and it is only when rest day is sacredly kept that it is most thoroughly restful. The farmer who neglects to avail himself of religious associations, who fails to connect himself with some religious organization, and who does not make use of these means to develop his spiritual faculties and to clarify his perception of the reality of that unseen world, so close to which many of his own every-day experiences bring him, is greatly the loser by such neglect and failure.

Is there any need of a class association for farmers? — something which finds scope to work within the broad field of the farmer's interest, and does not try to go outside of it; something selfish, perhaps, but, if so, not with a selfishness which is narrowing or mean; something which will lift up the farmer's life, but not pull down any worthy interest; something which will put the farmer upon equal footing with his competitors, enable him to do his best work, and secure fair compensation for it. I have kept this question pretty well in the background, but it is now time for it to come to the front and receive attention. Do the special interests of the farming class require association and organization for their protection and furtherance? Do the greater general interests of the whole community which are placed in the farmer's hands require that he shall employ the power of association in the service demanded of him? To my mind, there can be but one answer to these questions. All the con-

siderations bearing upon the matter marshal themselves in solid phalanx, and press forward to the one conclusion. The tillers of the soil must have an association of and for themselves. They may make use of those associations which care for the interest they hold in common with others, or which express the feeling and thought of common humanity; but, in order that they may rightly use these, they imperatively need an organization which shall be all their own. In this they can find the training which will equip them for effective service in other associations In it they can give the necessary attention to their business interests, and, with the advantages it furnishes, may meet the trader upon more nearly equal terms than when isolated and unprepared. Here, too, each individual farmer can find help for his own particular battle; for I think, in farming as in no other business, the strife is individualized. It is, like the old Homeric wars, a series of personal combats, instead of being, as in modern warfare, mass against mass. Thus each farmer has his own peculiar combination of adverse conditions to meet, to fight, to conquer if he can. No one else can fight his battle for him, but others can help him wondrously by the stimulus of success in conditions different indeed, but no harder than his own; by the suggestion of principles and methods capable of adaptation to his case; and by the cheer which comes from simple contact with others of like interests, trials, difficulties and hopes. He needs the power of association and the machinery of organization to bring this help to him in adequate measure.

I have already spoken of the close relation existing between the farmer's business and the home life of himself and family. The association which is to fit his needs must take this fact into consideration, and serve him socially as well as in his business interests and his relations as a citizen. Perhaps there is no point in the whole circle of his needs where the demand for relief is more imperative than here. Most sorrowful indeed are the pictures, truthfully drawn, of the isolation, the monotony, the round of unvarying and unrelieved drudgery with which the cup of life is filled to the brim for the members of many farm households. We may and do protest against the assumption that these are typical

farm homes, or that such harsh features and dark lines are inevitable accompaniments of farm life. Their existence may not be denied, but the necessity for them is denied. But, if they do exist, and are not necessary, they ought to be removed; for, in themselves and in their effects, they are evil and hurtful. Not only do they sorely limit and mar the lives into which they intrude themselves, but they cripple the powers which should be used in the service of the public, and thus the evil comes home to everyone. This condition of things amounts to a disease in the social organism; and, medically speaking, association is the remedy indicated.

For the work we have to do, we need an association combining the elements of permanence, strength and flexibility. It must be permanent, for the dangers against which we would guard are permanent in their nature. It must be strong, for the work to be done is both great and difficult. It should be flexible, for it must work under widely varying conditions, and be operated by persons of every shade of temperament and every grade of ability, and of the widest possible range of differing opinion. To every one of these it must present some attraction, to draw him within its enclosure; some tie to bind him there, some stimulus to make him work, and results which will compensate him for all his expenditure.

Is there in existence any association which proposes to do the work thus outlined, which confronts these evils with power of resistance and machinery of conquest, which finds large acceptance with those whom it proposes to aid, and which brings in its hands the fruits of its work to accredit its claim to attention? If there be such an organization, bringing good credentials, every farmer should give it audience. If its credentials are sufficient to establish its ability to do the work we need to have done, then every farmer should welcome its coming, as hard-pressed soldiers on the field of battle welcome the coming of a strong reinforcing column. And I think such an association should receive a kindly welcome from good people in every walk of life. It is not for the advantage of any one that farm life be emptied of brightness and made repulsive to those whose tastes would naturally lead them to adopt it, and whose ability and enter-

prise might work effectively therein for the good of all. But, while a friendly interest in whatever is helpful to the agricultural class may be wide-spread and very general, the burden of maintaining an organization for the benefit of farmers must fall upon themselves. The work is theirs, and none else can, even if they desired, do it for them. Their help must be self help. Out of the peculiar difficulties which beset them, the farmers must extricate themselves. The obstructions found in their pathway they themselves must remove. If they ask help, they must ask it as allies, and not as dependents. They should not ask it at all, unless fully prepared to do what they can for themselves, and to render an equivalent for all the help they receive. If the criticism were made that farmers as a class failed in vigorous self-assertion, and in sturdy resistance where class interests are threatened or invaded, I, for one, should feel obliged to conceal the fact, though I might find, in the conditions which surround the farmer's life, much of excuse for it. But I want to be in such a position relative to this whole subject that I shall not need to deal in excuses at all. I hate excuses. I neither enjoy making them myself or having them made to me. They always imply failure, and you can never be quite sure that they justify failure, or show that it was inevitable. Failure can never be justified, so long as any reasonable, practicable, obvious means of averting it remains untried. Anything short of the highest success can be justified only by showing that every possible effort was made, and vainly made, and every available agency pressed into service, and found inadequate to attain it. Men must fail sometimes; but, if the hard necessity is upon one, let him so fail as to be under no necessity of making excuses. For a mean and narrow social life, for stingy contributions to the public weal, for nerveless grasp and uncertain guidance of public affairs, it will be hard for a class so strong in numbers and important in function as are the farmers of this country, to make any acceptable excuse. And there ought not to be any occasion for excuse. A mighty army in number, essential beyond all others in function, the farming class has but to lay hold of the power of association and right organization, and it will be equipped to give ample protec-

tion to its own interests, and make thorough performance of its work.

Of course equipment is vain unless used. Guns that are never fired won't keep off the foe, no matter how good they may be in themselves, or how perfect the condition in which they may be kept. A mill full of the best machinery ever constructed will accomplish nothing unless water is turned onto the wheel, or fire built in the furnace of the engine that is to drive it. A first-class equipment is magnificent, but it must have power to impel it and care and skill to direct it. I believe in good weapons for strife and good machinery for work; but I wish to guard my every utterance against the mistaken presumption that the best equipment is of any avail unless intelligently and faithfully used. Those who come into an association of any kind, and then stand idly by to see how the thing is going to help them, are not the ones to get good out of it or do good through it.

And now, good people all, who have heard me patiently so far, please give me credit for all the self-denial it has cost me to reach this point in my discourse without once uttering the magical word "grange." The time for that utterance will be no longer deferred. The name comes into the discussion as the thing which it designates comes into the farmer's life, in the fulness of time. Long waiting preceded it and prepared the way for it. Out of a brooding consciousness of need, this measure of relief was brought at last to life and light. I do not think it misnamed when I call it an inspiration, meaning by that term nothing supernatural, but something far more than the thought or the device of one man or of a small group of men. In some such way as Thomas Jefferson voiced the unspoken and perhaps unconscious thought and purpose of a new-born nation; in some such manner as railroad, telegraph and telephone have come in response to dimly perceived but real need; in the way in which, all through the ages, individuals or groups have voiced the thought of dumb masses, or wrought the work of relief for which the only demand was an unspoken need; in a way not exactly paralleled by any of these examples, but illustrated by them all, the minds of a few men became possessed with the grand ideal of an organized brotherhood of

the tillers of the soil. The whole story of the Grange indicates unmistakably that it is a growth rather than a contrivance. Its seed thought is that of brotherhood. This was enlarged to take in the idea of sisterhood as well. Is there a word in the English language which comprehends both? If not, there ought to be, and this would be the descriptive word to apply to the Grange. In its social relation and work the Grange recognizes fully the fact to which I have already called your attention, that agriculture is a life as well as a vocation. For all who share that life, she opens wide her hospitable gates and spreads her bounteous table. Manhood, womanhood, age, youth, wealth, poverty, those to whom many talents have been intrusted, and those charged with but few, so that they both be faithful users, — all sit down to the wholesome feast of the Grange, and rise up fed and strengthened. Her feasts which nourish the body fitly supplement those by which the mental and moral natures of all who come and partake are also nourished and strengthened.

But the Grange trains as well as feeds its membership. It is not by any manner of means a fat animal show. Not accumulation merely, but service, is the mark aimed at. The Grange wants its members in good working condition, and food and exercise are both designed to maintain this condition. If it did no other work than this, which is wrought wholly within itself and upon its own membership, it would be one of the grandest institutions of modern social life.

But, while the social structure and work of the Grange constitute the heart of the organism, it has other noble features, and sets itself to other important tasks. Next in importance perhaps may be placed its helpfulness to the farmer as a producer. Success in farming depends largely upon close attention to details of management. Take a representative group of farmers anywhere, and each one will have some point of management in which he is superior to all the others. Let them pool their skill, their knowledge, the devices and practices which each has proved and found profitable, and all will be benefited. Something of this sharing of treasures and exchange of benefits goes on through the agricultural press, and by means of the casual association of farmers in agricultural societies and other organizations; but

the diffusion of such information is immensely increased by the close association and unity of interest provided for in the Grange.

But this, too, as well as its social work, is all within the Grange. We have not yet touched upon its exterior work. And I confess that my own interest in this which I have thus hastily sketched has been so absorbing that the external work of the Grange has seemed comparatively unimportant. It is not, however, absolutely unimportant, nor has it been neglected. If my impressions are correct, it was the first thought of its founders to bring the power of association to bear upon the farmer's relation to the markets, as buyer and seller. They felt keenly the disadvantages under which he labored, and thought they saw in association a remedy for them. The results have proved their judgment correct, and justified their work. They thought, too, that by means of organization and concentration public opinion might be moulded, and legislation secured against evils which affected not the agricultural class alone, but with them other producers, and through them the great body of consumers. They believed that the grip of monopoly upon the articles of transportation must be relaxed, or no healthy, vigorous circulation could be maintained. They believed that falsehood in trade, working injury backward upon the producer and forward against the consumer, should be the subject of legislative prohibition and penalty. The interstate commerce law and the oleomargarine legislation of the several States and of the United States stand as conspicuous expressions of this thought. Both have been bitterly resisted and savagely criticised; and if indeed they are wrong in principle and evil in their fruitage, much of the blame thereof must fall upon the Grange, for it has done more than any other single agency to bring them to pass. The Grange does not shrink from this test. It believes firmly in the principle of the control of monopolies by the government. It believes in such supervision of trade as shall punish fraud, prevent harmful adulteration of food, and protect not the purses alone but the health as well of all consumers.

How trivial, in view of the work it has done and stands ready to do, seem the objections urged against the Grange. I

note a few of them. It is a secret organization, and secrecy may be a cover for evil practices. Very true; and it may be a shield for the purest and choicest treasures of humanity. There are interests which we all instinctively keep thus shielded. Individuals have memories and hopes which they keep to themselves, or share with the very few whom they wholly trust. The privacy of the family circle is a sacred one. There is use as well as a misuse of secrecy, and some of the choicest bloom and fruitage of life can be perfected only under its sheltering veil. Used as the Grange uses it, its fruits are good, and only good. Another objection to the Grange is the expense of maintaining it. That it does cost money to run it, is a fact, but not a valid objection. All good things cost something. Some one has to pay for every desirable possession. If not he who enjoys it, then some other person must foot the bills always. But this fact amounts to an objection only when it can be shown that cost exceeds value. If what you procure is worth to you more than what you give in exchange, and also worth more than anything else you could procure for the same equivalent, the only wise thing to do is to give the price and make the exchange. Now, the Grange usually returns in kind far more than the money expenditure required for its maintenance; while of that which money cannot measure, its returns, always liberal, are sometimes such as can hardly be exaggerated in statement.

The Grange costs to maintain it not only money, but time and thought as well. And, in regard to these, the same rule for selecting lines of expenditure prevail. We want the best return which can be had. Our capital is limited, ah, how sternly! We cannot afford to waste any of it. How can we best use these precious years, days, moments, coming, as they do, to us one by one, and never returning for use a second time? Failure here is utter failure. We may lose money, and still get along very well without it; but, if we waste time and thought, we are bankrupt indeed. And we must use this capital in some manner. It cannot, like money, be accumulated. It must be expended, if it is to do us or anybody any good. Can the time and thought expended in Grange membership and work be used to better advantage

elsewhere? I do not see how any one can answer Yes, and justify his words. My answer is the other way.

It may be said that there is danger in the Grange. It is liable to fall into the hands of bad men, be turned aside from the beneficent uses for which it was designed, and its misdirected powers be made to work evil. I do not deny the possibility of this. If any one requires of me a guarantee of absolute security against a wrong use of the power of the Grange, I shall decline to give it. I know of no other association in regard to which such guarantee could be given. "Eternal vigilance" is the price, not of liberty alone, but of most other good things as well. I invite farmers to join the Grange and entrust their interests to its keeping, not as passengers on board of a luxuriously appointed train, having no relation to its movement except to pay their fare and be carried to their destination. Themselves and their precious interests will be carried safely, if the conditions of safety are fulfilled. These conditions require that every person upon whom a trust is devolved shall be faithful to that trust. On board the Grange train, its members are not passengers alone, but engineers, brakemen, switchmen and trackmen, as well. They run the train, as well as ride upon it; and, if it runs to wreck, they alone are responsible. If this fact is an objection to the Grange, it is equally an objection to almost everything else in life, and indeed to life itself. There is risk in everything; there is danger everywhere, and no escape from its presence is possible. In that presence the cowardly policy is the worst conceivable policy. Trying to run away from its presence, we fall into its power. Facing it with manly courage and vigilance, we may live in its presence and resist or turn aside its power. "Out of the nettle danger we pluck the rose of safety;" and he who shrinks from the nettle may never wear the rose.

My thought of the future of agriculture never makes the farmer's life one of ease and luxury. It never dispenses with the homely virtues of industry and economy. But it does bring to the farmer just recognition and compensation. I want the land upon which he works to recognize him as its master, and yield to him from its store-house ample returns for his toil. The land will recognize its master when he

comes. When farmers fairly conquer the land, they may rule it, but never until then. I want this compensation and recognition to come also from the community in which the farmer lives; and I believe this, too, will come when fairly conquered. When, therefore, I assume that the farmer of to-day is without the compensation and recognition he ought to receive, I do so for the purpose of stirring him to action, and not in the way of weak complaint against any other class. Agriculture must fight its own battles, and conquer and hold what is of right its own. And it must use in this strife the agencies which are calculated to win. It must use the power of association. It must not be deterred by the inevitable risk, nor by the necessary cost, nor by trivial criticism of details of organization. It must go forward, even at the cost of some mistakes, some losses, some defeats. It is a campaign, and perhaps a long one, for which the forces of agriculture have enlisted; but who doubts that it will issue in victory? Not he who is in his place and doing his work.

I bring my discussion of the subject to a close at this point, admonished as I am by these accumulating pages that I have already overstepped the limit of time allotted me. But, until now, I have seen no point at which I could stop without very incomplete treatment of the theme. And I am keenly aware that much might still be added, not only to the extent but also to the force of my argument. But I do not know that I care, even if it were possible, so to treat the subject that nothing would remain to be said. I wish rather to start trains of thought which you yourselves will conduct to their right destination. I am not overmuch anxious that you should agree to all that I have advanced. Not without critical examination of it in the crucible of your own minds, would I wish you to accept any of it. But if, after severe tests, you do find that it contains the pure gold of truth, rough and unsightly though the enclosing ore may be, then I ask you to take that truth to your hearts; let it work out its appropriate fruit in your lives, and pervade with its blessings all the communities in which you dwell.

The Chairman. The subject is open for discussion, or for questions to be asked. I see Mr. Ely of Holyoke is here; we would be pleased to hear from him.

REMARKS OF MR. ELY.

Mr. President and Gentlemen: — I am a little surprised at being called up, but do not be under any misapprehension or any fear of consequences, because I do not propose to talk to you except to say how thoroughly I indorse the paper that has been read to you. It is a noble paper, and full of truth. I believe in the Grange. I do not belong to one at present, because the material from which the Grange has to be made does not seem to exist in my section, but I believe it to be a good thing. I am going over to South Hadley Falls and join their Grange, if they will let me in. I was in a Grange long ago. I do not know just when it started. If it has not been any particular help to me morally and intellectually, it has been a great pleasure to me. I well recollect how proud I was, at the meeting of the first State Grange I attended, to see the body of men collected together from the old State of Massachusetts, all the way from the place where that arm stretches into the Atlantic back to the hills of Berkshire. There were men there with whom I was proud to be associated. I said then, if you could put that body of men right into the State Legislature, it would greatly improve our legislation. There is not a town in this Commonwealth which would not be improved by having its young men belong to a Grange. I thoroughly approve of all that has been said. I did not get up to take your time, but just because your Chairman made a mistake in calling upon me.

The CHAIRMAN. I wish I could make another mistake equally as good. I shall now ask State Master BARTON to speak to us for a few moments.

REMARKS OF H. A. BARTON, JR.

As I stated this morning, it is a pleasure for me to be here and listen to the paper which has been presented to us, and the thoughts which have been given to the farmers that are gathered here; and with all my heart I can indorse the principles which the speaker has presented, for I well remember the time when I first joined the Grange, and I know well the benefit it has been to me. If there is one thing more than

another that I would like to have you carry with you from here to-day, it is this one thought — and not in regard to the Grange alone, but in regard to the State Board of Agriculture — which I forgot to state this morning, and that is, that we have perhaps half of our membership composed of mothers and daughters; and I believe if there is one thing more than another that would raise the standard of the State Board of Agriculture, it is this: that, when a man is elected from an agricultural society from any part of the State as a member of the State Board of Agriculture, his wife should also be a member, and occupy in a measure the same position. You would see this hall filled to-day with ladies, and with gentlemen too, young and old, if every member of the State Board of Agriculture had his wife with him here to-day. If your invitation included the ladies, they would appreciate it; but I fear they feel that it is a body of men simply, and they are not welcome, — not because the invitation has not been given, but because they feel there is no place for them. If at our State Board of Agriculture meetings we could have the ladies with us, and have such papers presented as we had this morning, it would help carry forward the work of agriculture in our State I am glad because of that feature in our Grange. The power of organization I do not believe is half appreciated by the farmers in the State; and to-day, if the farmers would realize that they can be united throughout the State, half a million dollars could be saved to them in one month. Last year, by coming together and buying our corn, we saved a large sum of money, compared with what it would have cost us if we had bought it of the regular dealers. The dealers are not to blame, for they only charge you a proper increase where they deal out the grain in small quantities, and somebody gets grain he does not pay for. Now, no matter whether grain is high or low, if you would arrange with your own dealer in your county and buy it by the carload, you could save three dollars a ton, and forty-five dollars a carload, fifteen tons in a car. Last year we saved six dollars a ton in buying as we did. You will not see this year the advance in grain equal to that of last year, because this year there is an immense crop; but you could make a saving by

buying your grain by the carload, and not of regular dealers. How can this be accomplished? Through the organization of the Grange. It can be accomplished through any other organization, if you had the opportunity to bring men together to arrange it. For instance, if you want perhaps five tons of grain, you do not feel like running all over town to see who wants five tons more; but if you have a meeting where it is stated upon the programme that you will call upon farmers who want to buy grain, they will come together, and you can see who wants to buy. And I wish the sentiment might go out from this meeting, that it is of vast importance to organize, even for this one object alone. It can be done, and it should be done; and you could save enough on your winter's grain to enable you to go to Boston with your wife and buy a good dress for your wife or daughter. This result can be obtained, if the farmers will work together.

Mr. S. A Hickox was then called upon, and he addressed the meeting as follows: —

REMARKS OF S. A. HICKOX.

Ladies and Gentlemen: — This call is very unexpected to me, but, in regard to the matter before us, I do not wish to seem to be unwilling to bear testimony. It seems to me that this meeting of the State Board of Agriculture has been a success, and first I wish to congratulate our Secretary for the good judgment he has shown in the arrangement of the programme; namely, in so getting it up that the papers have not consumed all the time. There has been a good opportunity for discussion; and though we find that there would have been more discussion if there had been more time, we have made quite an improvement on the programme of last year. In regard to the paper of this forenoon, that was presented so ably by Mrs. Chase, it seems to me that she gave us a true picture of the qualities that constitute a home on the farm; and though I do not feel that I can add to that picture, yet I would like to emphasize those ideas, and carry those thoughts with me to my home and see if I cannot use them there. Now, home on the farm, brothers and sisters, is a home to be desired. There we have the stock, the different kinds of

animals, we have the blooming fields and all the opportunities that the country gives, and have them for twelve months in the year, as the essayist called to our attention this forenoon. The people from the city have them for two or three or four weeks, and consider that a great opportunity; but we have them for twelve months, and can enjoy them and develop our minds and our muscles, and bring forth results in the fields that people from the city and country alike will come forward and compliment. I esteem it a privilege to live in the country, and to be the head, if you please, of a country home.

Now, a home in the country, as well as in the city, must have a center, and the center of the home should be the housewife and mother. It is necessary for the body to have a head. Is it not as necessary that it should have a heart? That good mother in the home represents the heart of that home. She should represent it, and we should do those things that will assist her in bringing out those other features that the essayist mentioned this forenoon. It seems to me that, while these facts have been brought so vividly before us this morning, it is our opportunity to profit by them, and carry them with us to our homes in the country; and I cordially indorse that suggestion of the gentleman a moment ago, that we bring our wives into these meetings of the Board of Agriculture. I believe that it is one of the ways to strengthen these meetings, and make them more beneficial.

Now, I hope you will pardon me, but I wish to say one word more. I believe the day is coming when we shall have such homes on the farm as were pictured to us this morning, and I believe they will be brought about largely through the influence of such organizations as were described in Mr. Hubbard's paper, where the families of the farmers of the State may come together, and become cognizant of the privileges and opportunities they may enjoy, and of the difficulties they have to overcome. If we can intelligently understand the difficulties, it is more than half the work of overcoming them. I have been in the Grange but a short time comparatively, but I find it is a benefit to the farmer, and I believe it is your privilege to join it and be profited thereby. I believe it is your duty as a farmer to come forward and enjoy

the benefits which the Grange will bring to you and your family. We are meeting the different combinations of the country, and if you think that you are smart enough to meet these organizations alone and keep yourselves whole, why, you will go on until you find that you cannot. I am convinced that I cannot meet them successfully, and I believe that none of us are able to meet them alone. Let us join together and meet them. Never let us give up our industries nor our hard labor because others say we must. If there is any principle in the Grange that is not right, let us do away with it. If the Legislature does not give us the protection that our industry demands, we can act unitedly in bringing about the laws that we need, so that producer and consumer shall be dealt with alike.

I thank you for your attention. I am glad we have heard of a home on the farm. Let us think that these homes are nothing more or less, if we look at them aright, than typical of the home of homes; namely, the home that we all are going forward to in heaven above.

The CHAIRMAN then called upon Mr. A. W. CHEEVER, who spoke as follows: —

REMARKS OF A. W. CHEEVER.

Friends: — I hardly feel that I have anything to say at this hour that will add to the usefulness of these three days' meetings. I can say for myself that I have enjoyed this meeting in some respects above any other that I have attended during the sixteen years that I have been a reporter for "The New England Farmer" at these country meetings of the Massachusetts Board of Agriculture. I have learned here that once, away back in the early history of this Board, Mrs. Ednah D. Cheney did speak before the Board of Agriculture.* It was news to me. It was before I had attended. I supposed that the lecture to-day by Mrs. Chase was the first ever delivered by a lady before this organization, and I think we may about as well call it the first; for, if there was one previous to this, that we have all forgotten, it is safe to call this the first once more. It has been my fortune, as connected with the press, to be present at a good many meetings, not

* Agriculture of Massachusetts, 1871, p. 156.

only in Massachusetts, but in other parts of New England and of other States. I have been over the State of Maine several times, aiding Secretary Gilbert in holding institute meetings similar to this. I have attended the Connecticut Board meetings annually, with scarcely an exception, for fourteen or fifteen years, and I have been West two or three times to attend agricultural meetings. I must admit that I have said privately to some of my Massachusetts friends, that Massachusetts agriculture is not recognized by its own people as it should be. Massachusetts as an agricultural State does not take the position it should; and, compared with some of our other New England States, it is, and has been for years past, sadly behind. In Connecticut they have a three days' meeting that begins in the morning of the first day with a well-filled house, and continues through as late as ten o'clock of the third evening, with nearly as large attendance as at previous sessions. The interest is kept up all the way through, business crowding all the time. And why is it? It is largely because the wives and mothers, the daughters and sisters, are there with their husbands and brothers and fathers. I think it is fourteen years that I have known of the secretary of the Board of Agriculture of Connecticut having his wife present at the Board meetings; and from that time to this, the leading spirits in that meeting have had their wives present as companions from year to year. That custom has brought an influence into their meetings which has drawn out a large attendance of people in the vicinity, and that is one reason why their meetings have excelled ours in interest. It is very different where the farm-women look upon the agricultural meeting as a meeting of men, to which the husband is going for two or three days, leaving the cares of the farm for them to attend to. I am glad the secretary of our Board could this year announce that a part of this meeting would be devoted to a discussion of Grange matters. It is an excellent omen. It is an encouraging feature, for which we may be thankful.

I am also exceedingly glad that the secretaries of the different Boards of the New England States are invited to come here and take part in this meeting. It creates a good fellowship. It reminds each that it is not Massachusetts alone, nor

Maine alone, nor any single State, that each is working for, but that all are working for one common interest. New England once exerted a great influence in the nation. It was looked up to, but it is growing relatively small. Some talk about it as a little corner that has been left out in the cold, and they sometimes speak of Boston "culture" in a sneering way. I went out the past summer into the Territories of Dakota and Montana, to observe what was going on at the West, to learn of the condition of other parts of this country besides New England. It so happened that it was my luck to be the only New England person in the party. The others were from the Middle and Western States, and I think they enjoyed poking fun at New England agriculture. One said, that, "after seeing these broad prairies and this rich land, I fear you never can write editorials for your New England farmers with any courage." Another one spoke of New England as the place where they find six great stones and one small potato in each hill. [Laughter.] That was the kind of fun they poked at me, because I believed in New England. We all had to make our bow before audiences while exchanging congratulations. When it came my turn, I said: "My trip out here has opened a new view. I see things as I did not before. I used to think New England was bounded on the west by New York, that New England was a small corner of the United States; but I find, as I come out here through these Middle and Western States, and to the Territories, and cross these great prairies, that, wherever I meet two men, one of them was born over in New England, or at least his parents were. I find it has been New England all the way, and she is no longer bounded on the west by New York, but extends clear to the Rocky Mountains." [Applause.] If our smart New England boys have gone West, we should not be jealous of their success. We should expect our sons to outstrip us; but, if we desire to keep up the reputation of our New England States in the esteem of the people, we must use more of that sort of pluck and energy and persistence that our sons and younger brothers are showing in their newer States.

Mr. Alonzo Bradley of Lee. A few days ago I read in one of the Western papers an essay upon dairy farm-

ing. The essayist, in referring to New England, called it "that little State away down East." But there is this fact to be remembered: we raise the boys and girls here, bring them up under our New England orthodox principles, and send them West; and you will find the West is largely indebted to New England for the enterprise with which it is being built up. Now, we all acknowledge the need for the Grange, or some similar association, to enable the farmers to make their influence felt. Let me illustrate. A few years ago, on the Housatonic Railroad, we endeavored to form a milk association, in order that we might act with greater power and influence. A great deal of enthusiasm was manifested at the first meeting. I was appointed for the north end of the road, to see the farmers and persuade them to unite in the milk association. I entered upon my duties with enthusiasm; but, just as soon as I got a little away from the public thoroughfares, I was astonished at the difficulty of convincing the farmers of the necessity for action and enterprise. I could accomplish nothing. Now, the trouble is not with the farmers that are here; it is with those who are not here, those who are back on the farm, who do not attend these meetings, who are satisfied with their passive life. As has been remarked, time and again, I believe that farmers have duties and responsibilities, and now is the time to act. I think the matter cannot be too strongly pressed, — the importance of availing of this opportunity through the Grange organization. For those of us who are fully aroused to the importance of this thing, there is a work to do in arousing those that are indifferent. That is the class that we want to influence.

The CHAIRMAN. The Secretary has a few remarks to make, and then the meeting will be brought to a close.

REMARKS OF WM. R. SESSIONS.

Ladies and Gentlemen: — I have heard some things which seem to me like apologizing for New England. I take no stock in such sentiments. New England can stand up for itself in all matters of agriculture and manufacture. The other day a friend of mine who had not been in the East for

years came on from Dakota. I met him on the day of his arrival. He had come by way of Montreal, and over the Boston and Albany Railroad. He said, "What a country this is! I would not give a quarter section of Dakota for all the land between Boston and Wilbraham." I said, "You did not know you came through a county that produces the largest aggregate value of agricultural products of any county in the whole country?" He said, "No." But that is true. The county of Worcester produces more dollars' worth of agricultural products than any county in America. The capacity of Worcester County has not been commenced upon. The value per cultivated acre of products is something like fifty dollars, but only about one-third of the land is cultivated. What are you going to say to that? We have one town in Massachusetts that produces agricultural products to the value of two hundred and eighty dollars per cultivated acre. You see the capacity for improvement is sufficient for our day and generation, and for the generation of our children, if they will stay here. You have heard of the capacity of our cranberry bogs, and of the size of the apple crop, and of the opportunities for strawberry and currant culture, for creameries and the butter product. There are opportunities enough, if we will only put energy and enterprise into our work. I think we have received some instruction from the gentlemen here this afternoon which will help us put our shoulders together and accomplish something. Let us go away from here feeling that we have no need of apologizing for New England agriculture. There is no need of it. The product of the Western States they boast of is only about seven dollars per cultivated acre, while the value of the product of the whole State of Massachusetts is fifty-four dollars per cultivated acre. Let them boast of the West, but let us stand up for our section, and do something for its improvement.

Now, I want to thank these gentlemen that are here for the support they have given me in my endeavors to make this a successful meeting. I am indebted to the Grange, to the speakers, who have done better than I expected; and I thank you, and especially the people of these towns, for we have been cordially received. We have received all the help

possible, except a large audience, and I do not know but we have had as large a one as we ought to expect from Easthampton. It is a manufacturing town, and of course the people of the village are not interested in our matters. I am very sorry, however, that they did not take advantage of their opportunities last evening and the night before to hear the two lectures, which would have been heard in Boston or New York by large and appreciative audiences, — not but that the agricultural lectures were equally good, but those were lectures which would interest all classes.

The Chairman then adjourned the meeting *sine die.*

ANNUAL MEETING.

The Board met at the office of the Secretary, in Boston, on Tuesday, Feb. 5, 1889, at 12 o'clock, it being the Tuesday preceding the first Wednesday in February. In absence of the Governor, Mr. GRINNELL was chosen President *pro tem.*

The Board then adjourned until 12.30 o'clock.

At 12.30 P.M. the Board was called to order by Mr. Grinnell.

Present: Messrs. Bird, Bowditch, Bradley, Burnett, Clark, Cruickshanks, Currier, Cushman, Edson, Gardner, Goddard, Goessmann, Grinnell, Hartshorn, Hersey, Hickox, Holbrook, Howes, Loring, Lynde, Peterson, Rawson, Rowley, Sheldon, Smith of Amherst, Smith of Deerfield, Snow, Stockwell, Taft, Taylor, Varnum, Ware and Wood.

Voted, To take up the report on Public Meeting on the fourth day of the Annual Meeting.

Voted, To indefinitely postpone the matter.

Voted, To adopt the order of business of last year.

A committee of three to examine and report upon the credentials of newly elected members was appointed: Messrs. Hartshorn, Peterson and Rowley.

Reports of delegates being in order, the members made report of the societies to which they were assigned, which reports were discussed and laid on the table.

The Committee on Credentials of newly elected members reported the following duly elected: —

At large, appointed by the Governor, James W. Stockwell.

From the Bay State Society, Edward Burnett, for three years from February, 1887.

Barnstable Society,	NATHAN EDSON.
Franklin,	J. C. NEWHALL.
Hampshire,	D. A. HORTON.
Union,	C. B. HAYDEN.
Worcester South,	G. L. CLEMENCE.
Spencer,	JOHN G. AVERY.
Oxford,	D. M. HOWE.
Worcester North-west,	J. P. LYNDE.
Martha's Vineyard,	N. S. SHALER.
Middlesex North,	A. C. VARNUM.

The report of the Committee on Credentials was accepted.

Adjourned to 9.30 o'clock Wednesday.

SECOND DAY.

The Board met at 9.30 A.M., Mr. GRINNELL in the chair.

Present: Messrs. Avery, Bird, Bowditch, Bradley, Clark, Clemence, Cruickshanks, Currier, Cushman, Edson, Gardner, Goddard, Goessmann, Grinnell, Hartshorn, Hayden, Hersey, Hickox, Holbrook, Horton, Howe, Howes, Loring, Lynde, Newhall, Peterson, Rawson, Rowley, Shaler, Sheldon, Slade, Snow, Stockwell, Taft, Taylor, Varnum, Ware and Wood.

Minutes of yesterday read and approved.

Resignation of J. H. Goddard as member of Examining Committee of the Agricultural College presented and accepted.

A committee of three on Assignment of Delegates was appointed: Messrs. Sheldon, Ware and Bradley.

A committee on Time and Place for holding the Public Meeting was appointed: Messrs. Wood, Hartshorn and Currier.

A committee of three on Changes of Time of holding Fairs was appointed: Messrs. Cushman, Howes and Clark.

A committee of three on Essays was appointed: Messrs. Lynde, Holbrook and Hickox.

A committee of three was appointed to nominate members of the Executive Committee: Messrs. Taylor, Cruickshanks and Newhall.

A committee was appointed to nominate members of Examining Committee of the Agricultural College: Messrs. Hartshorn, Taft and Bird.

The reports of the delegates to the several societies were read a second time by their titles, and accepted.

The Committee to report names for the Examining Committee of the Agricultural College reported the nomination of George Cruickshanks to fill the unexpired term of Mr. Goddard; N. S. Shaler and A. C. Varnum for three years, — who were elected.

The Committee to report names for Executive Committee reported as follows: Messrs. Slade, Bowditch, Hersey, Hartshorn and Rawson, — who were elected.

Dr. C. A. Goessmann, State Inspector of Fertilizers, presented his report, which was accepted.

Dr G. B. Loring read an essay on "American Agriculture," which was accepted and will be found printed in this volume.

Voted, That the time for the election of Secretary be fixed at 11 o'clock, Thursday, and that the election of a member of the Board of Control take place immediately afterwards.

Report of the Examining Committee of the Agricultural College called for. In the absence of the chairman no report was ready. After some discussion, the Board adjourned to 2.30 o'clock P.M.

The Board was called to order at 2.30 P.M., Mr. GRINNELL in the chair.

Report of the Board of Control of the Experiment Station presented by the director, Dr. Goessmann, and accepted.

W. W. Rawson read an essay on "Market Gardening," which was accepted, and will be found printed in this volume.

The Committee on Time and Place for holding the Public Meeting reported, by their chairman, that the meeting should be held at Fitchburg on Tuesday, Wednesday and Thursday, December 3, 4 and 5. The report was accepted and adopted.

The Committee on Essays for next Annual Meeting reported as follows: —

ESSAYS.

Agricultural Societies and their Management, .	J. H. ROWLEY.
Choosing an Occupation, ...	J. H. GODDARD.
Tuberculosis, ...	DR. WM. HOLBROOK.
Soils of Massachusetts, ...	N. S. SHALER.

Messrs. Hickox, Howe, Horton, Cushman and Taft were appointed a committee to attend the Legislative Committee hearing on Friday next in the interest of Honest Butter.

Voted, That the Board of Agriculture petition the Legislature, in aid of the petition of the Board of Control of the State Experiment Station, for an appropriation for the erection of suitable buildings to accommodate the department of Vegetable Physiology, and that the Chairman and Secretary sign said petition for the Board.

Adjourned to 9.30 A.M., Thursday.

THIRD DAY.

The Board met at 9.30 A.M., Mr. GRINNELL in the chair.

Present: Messrs. Avery, Bird, Bradley, Clark, Clemence, Cruickshanks, Currier, Cushman, Edson, Gardner, Goddard, Goessmann, Goodell, Grinnell, Hartshorn, Hayden, Hersey, Hickox, Holbrook, Horton, Howe, Howes, Lynde, Newhall, Peterson, Rawson, Shaler, Sheldon, Slade, Snow, Stockwell, Taft, Taylor, Varnum, Ware and Wood.

Minutes of yesterday read and approved.

Mr. Sheldon made a report on the assignment of delegates, as follows: —

Amesbury and Salisbury,	G. S. TAYLOR.
Bay State,	J. H. ROWLEY
Barnstable,	W. H. SNOW.
Berkshire,	C. L. HARTSHORN
Blackstone Valley,	W. H. B. CURRIER.
Bristol,	WM. HOLBROOK.
Deerfield Valley,	V. TAFT.
Eastern Hampden,	J. H. GODDARD
Essex,	D. M. HOWE.
Franklin,	F. K. SHELDON.
Hampden,	G. L. CLEMENCE.
Hampshire,	F. G. HOWES
Hampshire, Franklin and Hampden,	E. HERSEY.
Highland,	E. CUSHMAN.
Hingham,	E. W. WOOD.
Hoosac Valley,	C. B. HAYDEN.
Housatonic,	E. F. BOWDITCH.
Hillside,	J. G. AVERY.
Massachusetts Horticultural,	G. CRUICKSHANKS
Marshfield,	J C. NEWHALL.
Martha's Vineyard,	S. A. HICKOX.
Middlesex,	J. W. STOCKWELL.
Middlesex North,	S. B. BIRD.
Middlesex South,	W. W. RAWSON.
Nantucket,	B. P. WARE.
Oxford,	A. P. SLADE.
Plymouth,	J. S. GRINNELL.
Spencer,	S. W. CLARK.
Union,	N. S. SHALER.
Worcester,	N. EDSON.

Worcester North,	A. BRADLEY.
Worcester North-west,	G. J. PETERSON
Worcester South,	D. A. HORTON.
Worcester West,	G. B. LORING.

Report accepted and adopted.

A committee of five was appointed on Public Meeting: Messrs. Cruickshanks, Hartshorn, Lynde, Clemence and Bird.

E. Cushman read an essay on "A Hundred Acres or More," which was accepted, and will be found printed in this volume.

At the request of the Board of Trustees of the Massachusetts Agricultural College, the following resolution was adopted: —

Resolved, That each society be recommended to consider the subject of agricultural education, particularly with reference to the Agricultural College, at one Institute.

It being 11 o'clock, the special assignment was called up, which was the election of a Secretary, to be followed by the election of a member of the Board of Control.

William R. Sessions was elected Secretary, and Dr. J. P. Lynde was elected a member of the Board of Control.

Mr. Grinnell called Mr. Taft to the chair, and read an essay on "Massachusetts Agriculture," which was accepted, and will be found printed in this volume.

The Board then adjourned to 2 P.M.

The Board met at 2.15 P.M., Mr. GRINNELL in the chair.

The Committee on Changes of Time for holding Fairs reported that the time for holding the Eastern Hampden be changed to the third Tuesday after the first Monday in September; the Middlesex to the fourth Wednesday after the first Monday in September; the Middlesex North to the fourth Tuesday after the first Monday in September; the

Martha's Vineyard to the first Tuesday after the first Monday in September; that the date of the Oxford be the third Tuesday after the first Monday in September; and that the date of the Spencer be the fifth Thursday after the first Monday in September. The report was accepted and adopted.

Voted, That the laws governing the Board of Agriculture and the agricultural societies, together with the requirements of the Board as read, be adopted and printed as an appendix to the Secretary's report for 1888, and also in pamphlet form for distribution to the several societies.

Voted, That the Secretary be requested to collect the remainder of the historical sketches, and with the Executive Committee edit and publish them when thought desirable.

Voted, That the Executive Committee be also a committee on Printing.

The following resolution was presented and adopted: —

Resolved, That each member of the Board visit the Agricultural College at least once during his term of service, and oftener if the money at the disposal of the Secretary for the payment of the traveling expenses of the members of the Board so warrant.

Voted, That the several agricultural societies are earnestly requested at their next annual meeting to fix the dates at which they will hold the several Institutes required by the Board, and the subjects they desire to have discussed at those Institutes, and at once notify the Secretary of the Board if they desire assistance in the procuring of lecturers.

The minutes of the last day were then read and approved.

Adjourned.

WILLIAM R. SESSIONS,

Secretary.

AMERICAN AGRICULTURE.

BY DR. GEORGE B. LORING OF SALEM.

I desire to call the attention of the Board to American agriculture as a part of the increasing and developing industries of this country. The rapid growth of all enterprise here constitutes one of the most important and interesting chapters in the history of civilization. The stories of discovery and conquest have charms which more prosaic occupations are not expected to possess, and yet they all sink into insignificance before the recital of the steady and triumphant march of the vast army of untiring and devoted sons of industry, who have cleared the forests and opened the mines, and chained the water-falls, and built the great highways of travel and transportation over valleys and through mountains, and erected churches and school-houses, and organized cities and towns, and fed and clothed and educated themselves, and have filled the commerce of the world with the products of their toil. The chosen career of the American people has been a career of peaceful industry, and our achievements on this field have won the admiration of the world, from our infancy to our maturity and strength. More than three-quarters of a century ago, Sheridan exclaimed, in the House of Commons: "America remains neutral, prosperous and at peace. . . . Turn your eyes to her. View her situation, her happiness, her content. Observe her trade and her manufactures adding daily to her general credit, to her private enjoyments, and to her public resources; her name and her government rising above the nations of Europe with a simple but commanding dignity that wins at once the respect, the confidence, the affection

of the world." And, contemplating the genius of our institutions and the vital force of our republic, De Tocqueville declared: "There will then come a time when there will be seen in North America one hundred and fifty millions of men equal among themselves, who will all belong to the same family, who will have the same point of departure, the same civilization, the same language, the same religion, the same habits, the same manners, and among whom thought will circulate in the same form, and paint itself in the same colors. All else is doubtful, but this is certain. Now, here is a fact entirely new in the world, of which imagination itself cannot grasp the import."

Unchecked by war, and defiant of all disaster, this republic has increased in population at the rate of a million a year during the last decade, rivaling now every country in the civilized world except Russia, and attracting to her shores vast communities of people from those crowded and impoverished nationalities. Thriving States and populous cities spring up here like magic. The products of new and fertile lands are borne to the great centres of trade which are created everywhere by the necessities of a teeming population. The civilization which is advancing with such rapid strides from sea to sea is indeed a civilization of thrift, intelligence and morality. Prosperous industry is here the pioneer of education: the cultivated farm and the profitable mill preparing the way for the library and the lyceum, the school-house and the meeting-house. Conscious of the responsibilities and duties which attend them wherever they go, and proud of that individuality which Freedom bestows upon every man who enjoys her influence, this aspiring and industrious people of our land have endowed schools and colleges, have established more than seventy thousand churches, have provided places of worship for more than twenty millions of worshipers, and have church property valued at more than three hundred and fifty million dollars. You will allow me to remind you of that wonderful development of industry out of which this mental and moral activity has grown, and in the encouragement of which the well-organized agriculture of the community has done its share.

In agriculture our growth has been extraordinary, and

accounts for that vast internal and foreign commerce out of which has grown so much of our financial success. It is not necessary to go back a half century, or even twenty-five years, to obtain the most gratifying evidence of our progress in the work of tilling the soil. But, starting in 1870, at which time we had reached an enormous production in proportion to our population, and making our comparisons with the returns of 1880, we may learn what can be accomplished in a single decade by a people constantly increasing in numbers and occupying new lands. In 1870 the wheat crop was 287,745,626 bushels; in 1880 it was 459,667,032 bushels. In 1870 the amount of cotton raised was 4,352,317 bales; in 1880, more than 6,000,000 bales. In 1870 the amount of Indian corn raised was 760,940,594 bushels; in 1880 the amount was 1,754,449,435 bushels. In 1870 the crop of oats reached 282,107,157 bushels; in 1880, 407,-859,033 bushels. In 1870 the tobacco crop amounted to 262,735,341 pounds; in 1880 it amounted to 473,107,573 pounds. The increase of agricultural products was nearly one hundred per cent in these ten years, and in the last year of this decade, out of this vast increase of our crops and products, our cattle export rose from $13,000,000 to $14,000,000; corn, from $43,000,000 to $50,000,000; wheat, from $167,698,000 to $190,546,000; flour, from $35,000,000 to $45,000,000; cotton, from $209,852,000 to $247,534,391; beef, from $7,000,000 to $12,000,000; lard, from $28,000,000 to $35,000,000; and pork, from $5,000,000 to $8,000,000, annually.

The law of this vast and growing industry, as we all know, is the cultivation of those crops which are adapted to a local market, and the occupation of lands lying near that market. Not yet has this law become universal, it is true; but it applies to all the other and thickly settled sections of our country, and goes with diversified industries wherever they create large cities and towns. Fifty years ago the farmer was compelled to seek his market near home, on account of the difficulty which attended the transportation of his crops. But the settling of new and remote lands and improved modes of transportation rendered the growing of the great staples necessary; and corn, wheat and provisions

occupied the farmer's attention, and opened to him remote and even foreign markets for his trade. This frontier farming, however, is but temporary, and must be followed by that systematic husbandry which constitutes the legitimate business of the American farmer, and carries him back to those days when agriculture was almost the sole business of the country, and when a prudent and industrious farming community was uniformly prosperous. While our large towns and our manufacturing States therefore provide markets for a large portion of the products of the West, they also support that more profitable system, which consists in a careful cultivation of the soil and in the economical management of small farms. The trade of this country to which I have alluded is immense, and the sources of supply in all their variety form an interesting topic for consideration.

New England requires about twenty million bushels of wheat, and produces only one and a quarter millions. New York uses thirty millions, and grows about twelve millions. The supply of this deficiency comes from the West, — from the Ohio valley and the prairies west of the Mississippi and the Missouri, — and costs from forty to fifty million dollars in years of good production, but still more in this year of comparative scarcity.

To assume, however, from the fact that New York goes West for six-tenths of her wheat supply, that wheat growing is an unprofitable industry there, would be an unsafe and unreliable conclusion. There are eight counties south of Lake Ontario which yielded, in 1879, 6,086,876 bushels on 377,269 acres; or eighteen and six-tenths bushels per acre, — a rate more than fifty per cent above that of Minnesota or Dakota, and somewhat higher than that of California for the same year. Thus an important part of the deficiency of other counties in New York was supplied by the surplus grown in the Seneca valley and its neighborhood.

There is another district lying eastward towards the Hudson, and southward towards the Delaware, that finds a greater profit in the dairy, — making a production in butter and cheese worth far more than the grain procured from the West. Not only are the home wants in the dairy products

supplied, but a large share of the one hundred and twenty million to one hundred and forty million pounds of cheese exported from year to year is credited to this district, bringing a vast amount of money from Europe, a part of which is contributed to the aid of the Western wheat-growing. Going still nearer to the sea-board, to Dutchess and Westchester and the fruitful sand of Long Island, we find more people and less wheat, and a soil devoted to market gardening, yielding, under the most favorable circumstances, a gross product worth a thousand dollars per acre, — enough to buy a quarter section of superior wheat-land west of the Mississippi. In the immediate neighborhood of New York City the product of market gardening swells to millions of dollars. Ten years ago the census reported more than a million dollars' worth in Queen's County alone, and the present enumeration must when tabulated show an immense increase for this suburban district. The neighborhood of Boston and Philadelphia and every other large city is monopolized by market gardens, and the country about Norfolk, Va., is mainly devoted to fruit and vegetables for Northern consumption. The fruits of the country, a perishable commodity, must be produced as near as possible to the point of principal consumption. The domestic fruits alone furnish a trade of large volume and value. New York City has a trade in domestic fruits of more than nine millions of dollars; Chicago, which supplies the great North-west, has about as much; and the other large cities of the country would swell the total amount to about sixty million dollars, including the great amount now sent from our southern latitudes. Could all the fruits sold in small cities and villages be added, and those consumed on farms and village lots be enumerated, it is probable, judging from careful deductions from available data, that the annual value of the fruits of the United States would not fall much below two hundred million dollars.

Thus the distribution of farm products is found to arise from a multiplicity of causes: soil, climate, nearness to large cities, prices of land and labor, facility for obtaining labor at required times or seasons, skill in special industries developed by long practice, conservative persistence in time-honored usage, and many other causes, serve to distribute in

patches, large or small, the crops which furnish the products of American agriculture. The great cereal crop of the country, Indian corn, which is only exceeded by grass in the universality of distribution, constitutes more than one thousand seven hundred of the two thousand million bushels of grain of 1879. It is found in every State and in every Territory, with one or two exceptions. Yet this crop cannot escape the law of special local attraction. The three States, Illinois, Iowa and Missouri, yield eight hundred million bushels, or forty-five per cent of the crop; and only seven States, including Indiana and Ohio on the east, and Kansas and Nebraska on the west, have ever any considerable surplus above the requirements of home consumption. The remaining thirty-one States and all the Territories produce but thirty-seven per cent of the crop, at a rate of only nineteen bushels per acre, — but half the rate of the yield of the corn belt. The receipts at the sea-board cities for exportation and consumption, including all kinds of grain, ground and unground, aggregated 352,921,452 bushels in 1879, and 369,559,607 bushels in 1880. The whole Eastern movement of Western grain, including shipments to interior points on the Atlantic slope, must somewhat exceed four hundred million bushels, — not more than one-sixth of the total production of an abundant year, and less than one-fourth of the lightest crop the most disastrous season is likely to yield. The relations which are thus established between the interests of our country not only affect the material prosperity of the farmer, but they provide him with that social enjoyment upon which the happiness of an educated people largely depends, and rouse him to that energetic action which gives strength to all his powers. The isolation of farm life incident to sparsely settled regions is one of the trials which the American is anxious to avoid; and when he leaves the outlying farm and secures a home nearer the haunts of men, he places himself within reach of the lyceum and the library, and easy and convenient intercourse with his fellowmen. The comforts and adornments of his home are increased; and farming becomes to him an occupation analogous to those branches of business which tempt men away from the loneliness of the country to the pleasures and

opportunities of the town. The tendency of the rural population of some sections of our country to abandon the exhausted farms and seek lands nearer a populous market, is by no means an element of agricultural decline. It indicates rather a disposition to take advantage of those circumstances which lead to more active industry and more profitable labor. It is the same spirit of enterprise which has induced many farmers to abandon general agriculture and devote themselves to special crops, and has led the casual observer to infer that the cultivation of the soil was being abandoned. I have known the statistical returns of many evidently thrifty and prosperous farming communities to indicate a reduction of the products of the farm, and to lead to the supposition, that, because the cereals and animal products were diminishing, the lands were deserted. But a more careful examination has always revealed the fact that it was a change in the industry alone which had taken place, and that for those crops which met with competition from the cheap and fertile lands of the West had been substituted the products of the market garden, with all the profit which goes with this mode of manipulating the land. As this system extends and manufacturing cities and towns multiply, the returns of our farms will be largely increased, and the average yield of our land per acre will be greatly enlarged. It is the intimate relation between our industries which makes general farming what it is, and will gradually make American farming what it should be The opportunity afforded the corn and wheat growers of the West and the cotton and sugar planters of the South, the fruit growers of Florida and the cattle feeders of the great mountain ranges, constitutes the mainspring of our agriculture, strengthened as it is by constant and rapid communication.

Connected with the power of productive lands, and the varieties of climate and soil, and the demands of an industrious and prosperous people, there goes of necessity a system of transportation which constitutes one of the co-operative industries of society. The energy and ingenuity of man have done much to bring all natural resources under human control; but it is modern methods of transportation which have given new value to lands, new opportunities to mills,

new markets and values to crops; and it may be safely said, that the addition of a powerful and rapid means of transportation has not only given new life to all the old industries, but has added a new one of inestimable value and importance. The labor and expense of exchanging commodities have been so far diminished in our day that every producing industry is now able to employ its time and means to the best possible advantage. No time is now wasted by the manufacturer in traveling from his mill to his market; none by the farmer in transporting his crops from his fields to the consumer. No limit is now put to the capacity of the mill, the capital absorbed and the hands employed, by distance and obstacles on sea and land. The farmer whose time and means and horses were fully employed in hauling the crops of a hundred acres to market fifty years ago, can now employ his force at home in increasing the crop of ten times that area of land, while it is harvested and borne to market by machinery. Lands which were once useless to the cultivator are now brought by rail to the very doors of the market required by their crops. And not only is the transporting capacity of each individual increased, but the force which can be retained for work on the land is vastly enhanced, as well as the profit on the crop itself. When, many years ago, the railroad from Springfield, Ill., to the Illinois River was opened, it was announced in a leading newspaper of that day, "One week before the railroad was finished, corn could be had here in any quantity at fifteen cents per bushel; now, not a bushel can be had for less than twenty-five cents." With a system of farming which I have defined, and a system of transportation which we possess, the producing power of American labor and land is almost unlimited.

The relations which have been established between these active and vigorous industries to which I have alluded have produced upon society, moreover, a degree of mental energy and general intelligence never equaled in any age of the world. In the affairs of life, now, a man's head is considered to be worth as much as his hands, — the relative market value of these two commodities having materially changed since the "common and concurrent mind" began to assert its supremacy. The necessity for economizing and utilizing

labor in every department of business has created a necessity for clothing labor with some degree of intelligence; and out of this elevation of practical service has grown that active, vigorous and untiring faculty for invention which forms one of the striking characteristics of the present age, and gives new force to all our industries, agriculture included.

That the prosperity of agriculture has kept pace with the increasing prosperity of every other industry in our land, is manifest. The activity of the grain-growing sections of our country has been and is great; and the demand for the product of the pasture and the stall has been most encouraging to those who supply the market at home and abroad. It may be that this encouragement of local and special crops has not been as great, and that the farmer is especially called upon to consider how he can secure a suitable reward for the labor which he applies to the careful and systematic tillage of the soil, to supply local markets with what they require, and for the care which he bestows on the orchard and the dairy. But, on the whole, the condition of the American farmer is looked upon as so satisfactory in every point of view that the lesson taught by him is engaging the minds of some of the most thoughtful statesmen and publicists of the old world. It has been discovered that the American system of land-holding, for instance, is the foundation of great popular content; and, accompanied as it is by great social and civil opportunities, surrounded as it is by the free institutions of our land, attended as it is by the school-house and the meeting-house, and by the constant call to public service which leaves but few exempt among us, it constitutes the foundation on which rest great mental activity, great dignity of character, great enterprise and ambition. To the practical work of the agricultural community here, wide-spread disaster, moreover, is unknown. The local damage of a drought or a flood is not indeed unusual; but the extent of our territory is such, the diversity of our soil and climate is so great, that the disasters seem to be circumscribed and accidental, while the prosperity is wide-spread and constant. With landed possessions which are obliged to bear the burdens of heavy taxation, with wages of labor vastly greater than in any of the countries of Europe, with the personal requirements of the

farmer and his family increased by social obligations and the natural demands of a free and responsible people, we have been able to compete in the grain markets of the world with those who, in some instances, are furnished with land free of rent and taxation, and whose necessities of life are so small and whose duties are so few, that the former seem intolerable and the latter seem insignificant and trivial. The skill of the American farmer, supplied as he is with the most ingenious and graceful and effective machinery, has become an object of admiration and imitation. The well-organized home of the American farmer is looked upon as a model. The place filled in the community by the American farmer is considered so important and honorable that other nations inquire how it has been attained. The crops of the American farmer are looked upon as so sure, that all anxiety with regard to the supply of food for the people less favored has passed away.

The rapid growth of this industry with which we are all familiar may be made more apparent by recurring to its condition in this country three-quarters of a century ago. At that time the ploughs were usually made by the village blacksmith and wheelwright. Shovel factories were few and small. Grain harvesters, reapers, mowers, tedders and horse-rakes were unknown. The mechanical enterprise engaged in producing these and other improved implements of husbandry is untiring; and in one year the patents issued for improvements in agricultural machinery exceeded 1,000, of which 36 were for rakes, 160 for hay and grain harvesters and attachments, 167 for seed planters and drills, 30 for hay and straw cutters, 90 for cultivators, 73 for bee-hives, 90 for churns, and 160 for ploughs and attachments. In 1810 our export of corn amounted to only 140,996 bushels; of wheat, only 345,024 bushels; of flour, only 748,431 barrels; the amount of cotton grown was only 124,000,000 pounds. Of the great increase in the number and value of cattle, horses, sheep and swine in this country, and of the development of the dairy as a source of profit to the farmer, it is unnecessary to speak. The annual production of more than $3,000,000,000 by the agricultural industry of this country is of itself sufficient to indicate the skill and energy of those who are engaged in all of its various branches.

This unusual and extraordinary growth which has thus far attended American agriculture is due not only to the diversity of our soil and climate, and the rapid increase of our population, and the vast improvement of our agricultural machinery, but to the independent ownership of land which characterizes American institutions. It were not easy to tell the strength and stimulus which come through the ownership of the soil to him who occupies it, has fixed his home upon it, and looks to it for his means of subsistence. The proportion of land-holders in this country to the aggregate population is great and significant, especially when we consider the reponsibilities resting upon them, and the opportunities which they possess. The increase in the number of farms in the United States, during the twenty years between 1860 and 1880, is remarkable. The aggregate in the entire country in 1860 was 2,044,077; in 1880 it was 4,008,907.

The increase by subdivision is largest in the cotton-growing States, where the share-tenant system prevails. In Texas the increase is by both subdivision and new land, the area in farms having nearly doubled in ten years; while in Alabama the enlargement is only twenty-six per cent, though the number of farms is doubled. The South Atlantic group shows an increase of 12.14 per cent in lands, 72.3 per cent in farms. But, notwithstanding the great division and subdivision of land in the United States, under the customs of the country and the laws of inheritance, and the demands of emigrants and settlers for government lands, in accordance with the various provisions of Federal legislation, a distinguished English statesman and economist has discovered that landlordism in America has "resulted in fixing on the free soil of the United States a land system that belongs to the era of barbarism;" and that "the tendency to landlordism in the United States is inevitable and immense." He declares that statistics show that "the popular notion that the agricultural classes of the United States own the soil they till to be incorrect;" and he adds, with the triumphant air of a prophet of evil, that "the United States possesses a quarter of a million more tenant-farmers paying rent to landlords than the three kingdoms and the principality together."

Confident that these startling statements will attract the attention of every member of this Board who is a land-holder

and practical farmer, I desire to present to your minds a few encouraging facts and some brief suggestions, which may satisfy you, at least, that you need have no fears that the system of landlording, which has nearly destroyed the agriculture of England, and has oppressed and distracted Ireland, will ever become an established institution in America. In the New England States, which are especially interesting to us, there are 207,232 farms, — of which only 17,597 are rented. These rented farms are occupied by tenants who are subjected to no violent restrictions, and they are owned by persons who in many cases have come into possession accidentally, — perhaps by inheritance, perhaps by foreclosure. The owners of these farms are often incapacitated by age from labor on the land, are often occupied elsewhere, and often hold these estates in probate. But seldom are farms of this description purchased as an investment, nor do they offer any inducement whatever to the capitalist. The condition of newer States, and of States in new conditions under the government, is somewhat different; but it is analogous in many respects. In Illinois and Indiana, for instance, the original large land-holdings are not wholly distributed in fee; and in some cases the original owners of small farms have removed to remoter and cheaper Western lands obtained on government terms, satisfied with the profit they have made by the sale of their holdings. For these reasons many farms are still rented, — farms which constitute a part of large tracts of land purchased in the early period of those States by Eastern capitalists, or taken as an investment by local capitalists, who preferred land with even a small income to the uncertainty of speculative stocks. In Illinois, for the above reasons, out of 255,741 farms, 80,244 are occupied by tenants, under the easy system of the United States. In the Southern States the case is somewhat different. Prior to the late civil war a great proportion of the lands in these States was occupied and managed by large planters. When the system under which they had been operated was broken up, the management of such estates was in most cases changed, and at the same time their sale in smaller divisions was found impossible, on account of the impoverished condition of those who would constitute

almost the entire mass of the small land-holders there. As I have previously stated, the number of farms in those States has largely increased: in Missouri, from 92,792 to 215,575; in North Carolina, from 75,203 to 157,609; in Georgia, from 62,003 to 138,626; in Mississippi, from 42,840 to 101,772; in Texas, from 42,891 to 174,184. In this increase there were but few purchasers, either emigrant or native. The emancipated colored population became tenants, and, as the number of farms increased, the number of tenants necessarily increased: Missouri having, in 1880, 58,892; North Carolina having 52,722; Georgia, 62,175; Mississippi, 44,558; Texas, 65,465. In all of the States, New England and Southern, many of the farms are rented on shares. The tenant is for the time proprietor. The obligations of his lease are easy. He stands on an equality with the land-holder, — and usually holds the commanding position. Of the 4,008,907 farms in the United States, only 1,047,505 are occupied by tenants of this description; and these farms are constantly changing from ownership to tenant occupancy. These figures must satisfy any one, even if he is determined to find the fatal disease of the republic in its land system, that the agricultural classes here do "own the soil they till," and that landlordism, as I have described it and as it exists, has few charms, and threatens no danger.

I might enlarge upon the division and subdivision of lands in the United States, as contrasted with that of the United Kingdom; but I will merely remind you that New England has five times as many farms as "old England," and small land-holders innumerable, with less than one-seventh of the population; and that 4,008,907 farms are held in the United States with a population of 60,000,000, while 50,000 landed proprietors only are counted in the 35,000,000 of people in the United Kingdom. Feudal tenure, moreover, does not exist here. Our ancestors left that behind them in England, and opened the way for that constant distribution of land, which, with the cheap and easy modes of transfer here, brings landed property into an active market. They left behind them, moreover, the entire system of tenant-farming, as established by long custom and intricate law in England; and the landlord has gradually disappeared.

It is hardly worth while, therefore, for any student of American affairs to discuss the land-holding and the agricultural problem here from an English stand-point. The relations existing between the landlords of England and their tenants need only to be understood here to be avoided. No argument with regard to the future of the United States can legitimately be drawn from them. In the famous discussion between Lord Beaconsfield and Lord Hartington, the latter was charged with having "prepared the country for the belief that the system of English agriculture is not formed on what he calls a natural principle, but, supporting three classes of the community, is one which has failed in consequence, and will never be restored." In reply to this, Lord Beaconsfield declared that there is no tenure of land which can be devised except on the condition of furnishing three incomes to three classes; viz., the proprietors of the soil, the farmers as a middle class, and the agricultural peasants, — those who toil with their own hands. To him citizen-proprietorship was unknown. The farmer, in his classification, was a peasant-proprietor, a tenant; the owner of the land is lord of the soil, the landlord. It is this complication which weighs down the agriculture of England, and has reduced much of the land lying around her great local markets to a sheep-pasture.

"Much of the land of England," says Mr. Caird, "a far greater proportion of it than is generally believed, is in the possession of tenants for life, so heavily burthened with settlement incumbrances that they have not means of improving the land which they are obliged to hold." While we hear on the one hand constant complaints from the owner of the vast demands of his landed estates for buildings, drainage, machinery and improvements of every variety, we hear constantly on the other of the embarrassment created by that law which "took away all claim of the tenant over every addition he had annexed or incorporated with the land, the moment that his interest, whether yearly or by lease, expired;" and confiscated all his "property in any engine or machine annexed to the soil, though for the express purposes of the farm, and without which it could not be profitably occupied." In fact, all law governing the relations between

landlord and tenant in England "is based on the feudal system, which gave the landlord a certain superiority over his tenants." No such state of affairs exists or can exist in the United States.

Says Hoskins: "The real property laws of England, from the period immediately succeeding the conquest down to the present time, present a history consistent with itself in one particular, — that of a perpetual struggle of rival interests. The parties to the conflict have differed in successive periods; the feudal sovereign, the baron, the churchman, the lawyer, and the land-owner, have each entered into the strife in turn, — each as the pressure of adverse power or of selfish interest impelled them. The result of all these struggles was the system bequeathed two centuries ago, and under which, with slight modifications, the business of the country is still carried on. But in those struggles there are two voices that were never heard, two interests little thought of, — those of the political economist and the agriculturist. Can it be wondered at, if the state of those laws be found productive of results injurious to the best practices of the one and violating the first principles of the other? There is in the history of England no instance to be found in which the ripened and intelligent desire of the community — clearly and repeatedly expressed through the most public, the most able, the most learned channels, upon a subject which has received prolonged and exhaustive investigation by a succession of royal commissions — has waited so long and so patiently upon the hand of legislation as that which has asked for the reform of our law of real property, — especially as affecting the acquisition and transfer of land. Whether the question be looked at from the point of view of the jurist, as a question of law reform, in the restoration of simple and inexpensive instead of complicated and costly procedure; or from that of the agriculturist, in respect of the influence that this branch of the law exercises over our most important home industry; or from that of the political economist, pleading for the rights of the community in the distribution of public wealth, — the cry is still the same: Free the land; release it from the shackles in which time and custom and interests — long passed away — have entangled it, obstructing its adaptation

to the uses of modern life, and presenting it as an anachronism upon the face of our institutions." Until these demands are gratified, until the tenure of land in England is reformed, until the tenant is relieved, and the farm-laborer is lifted above starvation, — the advice of the English economist will be of little value, his condemnation of our land system will be of no effect, and his prognostications will have no terrors for us.

The general distribution of land, to which I have referred, the independence of land-holders, the absence of severe legal restrictions, the freedom from restraint, and the social equality which characterizes this country and gives every man his opportunity, and clothes him with unusual obligations, — all conspire to stimulate agricultural investigation, and to rouse the popular mind to great activity and constant inquiry into all problems relating to this industry. By associations innumerable, by colleges, by competition at fairs, by the explorations of science, every branch of farming is explored, and all the results of experience are formulated and arranged for the guidance of the learner and the encouragement of the expert. The readiness with which the American farmer apprehends a successful application of his labor to the land, and his keenness in avoiding unprofitable speculations and doubtful operations, have secured to him a degree of general prosperity hardly found elsewhere. There is no doubt that his business is attended with more success than is that of his fellow-laborers on the land in any other quarter of the globe. From the market gardens around our large cities to the broad fields which supply the staples for commerce, — cotton, corn, wheat, beef, pork and products of the dairy, — there may be found, as I have already said, a successful agricultural enterprise in the hands of an industrious and sagacious people. Understanding well the varieties of climate in which they live and the varieties of soil on which they labor, recognizing the demands of the markets they are to supply, they seldom fail to adopt that branch of their business which promises the largest return. Blessed with a diversity of soil and climate and a breadth of territory unknown to any other people, they are free to make their choice, and are never compelled to force upon

any section an inappropriate crop, or to call art into competition and unequal strife with nature. While exercising an instinctive judgment in their calling, they are always ready to enter upon any inquiry which may afford new light and open new paths. To no agricultural community on earth can the student of economy address himself with more assurance that his views will be considered and his theories tried. It is indeed difficult to determine whether the American farmer displays more activity and skill on the fields he cultivates or in those wider fields upon which he enters with the scientist and the theorist. It is not surprising, therefore, that the careful and observant student of social and civil economy should be tempted to lay his views before so intelligent and appreciative an audience. Nor should he be disappointed if his theories are slowly adopted and carefully investigated. And it is curious and interesting to witness the modifications which take place in the agricultural industry: how a crop prevails under favorable circumstances for a period, and declines under adversity; how, as interests require, the application of labor varies; how the wholesale and somewhat rude farming of a sparsely settled region will be converted into the most ingenious processes by being brought into contact with wealth and a populous community. And this law no agricultural theory, no agricultural experiment, can defy. And yet in this lies the farmer's temptation The beaten path grows dull, and he longs to leave it. Investigation and experiment are full of charms and promise, and he becomes a willing follower. His fields he devotes to a new and untried crop, his stalls to a novel industry, — too often to his cost. Let me illustrate.

For many years the New England market has been supplied with beef, mutton and pork from the West, to a very considerable extent. It is now proposed to establish beef factories, so called, in New England; and, as I understand, to fatten beef in these factories on the products of our cornfields converted into meal and ensilage. This question I will not discuss myself; but I will give you such facts as I have with regard to the production of beef elsewhere, and leave you to judge of the profit of a beef factory. Before

laying before you these facts, I would suggest that beef-fattening, like corn-growing, may, as I think, be subsidiary work on a New England farm; and I cannot therefore too highly commend the enterprise of those who have brought among us the best breeds of cattle for beef and the dairy; nor can I fail to express my admiration of the wonderful specimens of heavy cattle, pure-bred and grades, which are often found at our agricultural fairs. I consider a well-made working ox to be a part of the economical labor of a well-regulated farm; and I shall rejoice in their increase in New England, whenever the farmers find it for their interest to use them; and I am sure every farmer will agree with me that a model dairy cow should be as remarkable for her thrift as for her dairy qualities.

While you are considering the advantages of fattening beef in New England, and calculating the profits to be derived from beef factories, I desire to call your attention to the methods by which beef on the hoof is brought to the great Western markets, and the expense of getting it there.

The three greatest markets for cattle in this country are Kansas City, Chicago and St. Louis. Ranch cattle destined for these markets are secured at a cost of about three dollars and forty cents per hundred pounds, at three years old. When a year old, they are purchased for about twelve dollars per head, — or two dollars per hundred live weight of six hundred pounds. They are fed on the ranches until three years old, during which time they usually add three hundred pounds to their weight, and one dollar and sixty cents for each hundred pounds to their value; making seventeen dollars as the result of two years' holding, less the expense, which it is safe to place at two dollars per head per year. These animals are called "feeders," and are purchased by farmers for about twenty-five dollars per head. Most of them are driven through the corn fields of eastern Kansas, eastern Nebraska, Illinois and Indiana, to be converted into beef. It is estimated that corn at twenty cents per bushel can be converted into beef at a profit, at the prices which have obtained during the past ten years. At twenty-five cents per bushel the profit is less certain; and at thirty cents per bushel the profit is exceedingly doubtful.

The weight of these cattle when ready for market is about twelve hundred pounds, and their value six dollars per hundred. Thus we have added one hundred per cent to the original cost price, and thirty-three and a third per cent to the original weight. All expense, such as freight, commissions, etc., from the feeding point in Kansas to Chicago, will fall within three dollars per head. Feeders in southwestern Kansas are in the habit of feeding large numbers of steers in a most systematic manner. They purchase their cattle at about three dollars per hundred pounds on the hoof, early in December, and supply them with corn so arranged in cribs that they can help themselves. Water is supplied by a running stream. No hay or fodder is fed, and one man only is required to take care of the herd. The cattle are fed until the first of May, and are estimated to consume each seventy-five or eighty bushels of corn during these five months. The refuse of the corn is consumed by hogs, the profit on which during a successful season is estimated to pay for all of the corn fed out. The cattle, when driven into the feeding enclosure, have cost from twenty-five dollars to twenty-seven dollars per head; during the feeding season they have consumed fifteen dollars' worth of corn, and are sold, according to the above estimates, for about seventy-two dollars per head, delivered in Chicago, at a cost, as I have stated, of three dollars. The profit on cattle fed in this manner is easily estimated.

But there are many cattle reaching Chicago which are wholly unfit for beef, and require additional feeding for the market. These cattle can usually be purchased for about fifty dollars per head; and they have been shipped to New York and thence to neighboring farms at the rate of three dollars per head. You will be interested in an estimate of the expense of converting these animals into marketable beef, as compared with the estimates I have given of feeding in the West. It is evident, I think, that we cannot afford to feed eighty bushels of corn, worth in the Eastern market at the lowest calculation fifty cents per bushel if brought from the West, and more if raised on our own farms, amounting to forty-eight dollars, in order to bring a nine hundred pound steer up to twelve hundred pounds. Sixteen dollars per

hundred is a pretty high price to pay for beef on the hoof. And, granting that two steers can be fed on an acre of corn, an estimate suggested by the advocates of New England beef factories, is there any farmer here who would consider six hundred pounds of beef, live weight, to be a sufficient compensation for the corn crop of an acre — the market value of the beef being thirty-six dollars? The conversion of this crop into meal and ensilage it seems to me can hardly mend the matter, —considering the cost of grinding the corn and packing the fodder into a silo. I have said nothing of the interest of the money invested in a beef factory, — thirty-two thousand dollars, I think,—and the expense of labor employed in the care of the cattle. I have, moreover, allowed to all animals an equal aptitude to fatten. Mr. Burleigh of Maine, one of the best judges of cattle I have ever known, a farmer who, by his judicious and bold importation of the best blood of England into our country, has conferred a lasting benefit on the agricultural interests of all these States, says: "Many times I have fed animals equally well bred and with equal care, when one would gain three pounds to the other two." And, while I believe in ensilage for certain purposes, and feel quite sure it is a convenient and profitable food for my dairy cows during the dry pasturage of late summer, and in the stable confinement of winter, I shall wait with interest for the result of Mr. Burleigh's experiment in making "a test between ten acres kept in grass, and the same number in corn and fed as ensilage," — fed, I suppose, for beef.

From the visionary speculation of such a proposition as beef factories, erected when corn and roots and hay are dear, and labor expensive, we turn to the practical experiments of the colleges and experiment stations established in almost every State in the Union, and to the intelligent cultivator on his land, with the expectation that long-mooted questions of agriculture will ultimately be settled to the farmer's satisfaction and profit. While he cannot afford to waste his money in doubtful experiments presented by advocates and not by investigators, or his time in useless inquiries into phenomena real or imaginary, which have no value among the processes of nature, even when they happen to exist, he can accept the results of the work performed by the practical scientists,

who draw their conclusions from facts, and do not endeavor to bend their facts to their theories. When the Maryland Experiment Station obtains and publishes definite results from the cultivation of the potato, and the New Hampshire Station lays down combinations of food for the different objects of feeding, tested on the different animals fed, they are engaged in disseminating useful knowledge, and stand by the side of the farmer in his labor. It is this form of investigation which may lead and guide American agriculture in the career which is constantly opening before it as the industry of an independent, land-holding people, to whom pseudo-science is an obstacle and a hindrance.

MASSACHUSETTS AGRICULTURE.

BY JAMES S. GRINNELL OF GREENFIELD.

To write upon the farming of Massachusetts, is, to use an agricultural simile, much like "threshing old straw," having as a subject been most thoroughly canvassed, — as declining or advancing, according to the views taken of it by those more or less informed, — in essays, in wise or unwise scribblings, in agricultural and other papers, and as discussed in farmers' institutes and clubs. A somewhat labored paper was read before this Board in 1882, when it was believed to be shown that, in the growth of the agricultural population; in the much greater comforts and even luxuries now enjoyed; in the intellectual and educational advance; and in the vastly increased returns from the whole agricultural products, notwithstanding a great diminution in some principal articles of food consumption, — the farmers of Massachusetts were much better off than they were forty years ago; and recent examination confirms this judgment.

The farming and farm productions of Massachusetts have been and often are slightingly mentioned and ridiculed by farmers and newspaper writers and politicians of other newer and larger States, who usually, in merely regarding the enormous productions of those States as the only test of what farming should be, seem to be quite unmindful of the part Massachusetts men have taken and now hold in forming the agriculture of the country, in developing and maintaining the best rules and principles of good husbandry, and originating the implements by which these great results have been accomplished; and also the prominence Massachusetts now holds, by her Board of Agriculture, her Agricultural College,

her numerous agricultural societies, and her thousands of active and intelligent farmers.

While Massachusetts agriculture at the present time may not have a very great influence on the whole country, to us, citizens of the Commonwealth, it is much, and its decline, if there were any, would be serious; as the widow of an old Scotch laird, who was beheaded for being "out in '45," said, of his misfortune, "'twas nae gret thing of a heid, but 'twas a sair loss to him." Our missions are different: they of the larger States are as foreign missionaries, to send provisions throughout all the world; we, as home missionaries, are to feed our own and fit them for service elsewhere, — a limited field, but quite as important.

Our population is now two millions, — more than twice what it was in 1845, and requiring, of course, food in the same proportion.

While, to be sure, the larger part of the staple provisions, the meats, and of all the cereals, is supplied to us from the Western producing States and Territories, there is yet necessary, for the use of the consumers, who are to the producing farmers more than twenty-five to one, a very great amount of food material to be grown by the agriculturists of our own State, and which is proportionately increased much beyond the advance of the population.

There are various ways by which the condition of our farming at present, as compared with past years, may be judged. The first — the most natural one, and the most uncertain and delusive — is the individual view taken by a superficial observer, who judges from the daily talk of farmers, and hears their grumbling of hard times; low prices for what they sell, high prices for what they buy; the difficulty of procuring labor; their everlasting complaints against the administration of the seasons; of edacious taxes; diseases in animals and crops, and the horrors of the insect world, in which are found, it is said, over two hundred thousand species, all of which the farmer believes are arrayed against him, and mostly in active operation. Trustingly to listen to these environments of the farmer, one would hardly suppose he had a comfortable home, and from the products of his farm enough for himself and family to eat, drink and

wear; to clothe them all; to educate his children; to pay for stated preaching, and enjoy it; and generally to improve his farm and his animals. The farmer regards himself as bearing to the fullest extent the primal curse imposed by the Almighty for "man's first disobedience by the fruit of that forbidden tree, whose mortal taste brought death into the world, and all our woe." To him alone, of all occupations, comes the doom, "cursed *is* the ground for thy sake; in sorrow shalt thou eat *of* it all the days of thy life."

While his life has more freedom and independence of action than others enjoy, it is laborious, and made more so by the constant trials and contests against forces of nature, from which other occupations are exempt.

The farmer is naturally a pessimist in his talk, and conveys in his conversation discouraging ideas. He is not usually inclined to admit that he is making money. He sometimes brags that his lambs brought a pretty fair price, though qualified by the statement that he ought to have had a little more; that his steers had done very well, but the market was a little down; that his shotes at seven months old were fat, and brought more than he expected, but, if he had kept them a week longer, he would have got a quarter of a cent a pound more. But he does not expect these little ebullitions of success to count and be remembered, and especially not to be recalled on the first of May. He inclines to the belief that the assessors are natural enemies, and he does not purpose that they shall have any insight into his affairs more than the law allows.

The two inevitables are before him, — death and taxes. The first he prepares himself to meet indefinitely and indifferently; the other, to avoid if it be possible, consistent with the most attenuated honesty. Next to the icy hand of death, he dreads the frosty touch of the collector of taxes.

This secretive tendency in this direction, natural to all, is more developed in the farmer, because all he has is, or ought to be, in sight: in his land, his buildings, his crops, his stock, and his implements and machines, — visible subjects for taxation, on which he often pays for the support of his government and his church more than his wealthier neighbors in other vocations, more lucrative, if not as honest, the

results of which are everlastingly concealed, entombed in the sacred vaults of a trust and security deposit company. This continued deprecatory talk of the farmers themselves, of the unprosperous condition of their profession and of themselves, is supposed, but wrongfully, to be a true exposition of Massachusetts farming, as coming directly from those engaged in it. It will not stand the test of analysis, is disproved by the census returns, the assessors' books, and is based largely on a false standard of values, brought on by the condition of the country a quarter of a century ago.

I quote from a paper read here seven years ago, more than ever convinced of its soundness.*

"Without any doubt, the most prevailing and best credited reason among the farmers themselves, and coming nearest home to them, for believing that agriculture has declined in Massachusetts, is in judging from the fallacious stand-point of the very high prices which they obtained for agricultural products during the late war and for some years after its close. Through that fearful strife, when more than a million of able-bodied men from the North were changed largely from producers to consumers, the government, obliged to support them in the field, was, from the inadequate supply of all articles of food and clothing which come from the farm, forced to pay very largely for them; and thus a scale of prices was established through the country far above the rates which had prevailed before the war, and which we had been accustomed to receive.

"These, with the inflation of the currency, induced among us more extended cultivation; and this, with a scarcity of labor, enhanced the cost of all that we produced. This increased production continued for some years after the war, and prices were still kept up, and it was a long time before they were brought down to *ante-bellum* times. In the long run, it was a misfortune for our farmers to have received such high-sounding, paper-money prices as they did for everything they made, raised or grew during that period.

"A factitious value was created, which could not and did not continue very long after the emergency causing it had passed, — but long enough to have wrought conviction in

* Agriculture of Massachusetts, 1881, p. 379.

the minds of the producers that it was to be permanent. It was disappointing and hard for farmers to realize that this was not to be, and they did not cheerfully nor readily return to normal prices. This condition, existing for eight or ten years, with a reluctant return to old rates, has given an impression of a general decline in agriculture which is disproved by safer tests."

Much the same conclusion is drawn by a casual observer in driving through some rural districts, settled long years ago, and even now remote from railway connections or a convenient market, quite outside the radius of a manufacturing or a commercial centre. He sees farm-houses, barns and buildings going to ruin, — good, comfortable homes in their day, where large families have been raised, members of which have gone out to colonize new lands, or to give additional impulse to the throbbing beats of great business centres, by the infusion of new, hearty, healthy blood. They have gone, not because farm work was too hard, not because farming would not give them a good living, but from a proud, restless ambition to be independent

But, while looking upon these evidences of thrifty, happy homes, once so cheerful and prosperous, now "touched by the mortal finger of decay," and crumbling into ruins, it seems to him as a picture of desolation; and from these he generalizes that all the agriculture of Massachusetts has quite declined, and that the State is being depopulated of its rural inhabitants to a greater extent than is the case.

But, when he descends from these rough heights to the neighborhood of a railway station, a manufacturing village or a popular resort for summer residents, he will find that these people from the hills have only sought a convenient market for agricultural products, easier grown and more remunerative on smaller holdings of better land, without thereby decreasing the population of the Commonwealth. If he extends his inquiries into the cities and large towns, he will find, among the wealthiest merchants, the ablest financiers and most successful business men, many who as farmers' boys commenced with sweeping the store or driving trucks; many of the most prominent in the learned professions who left the farms because of lofty ambition and want of

room. He will find the controlling men on the railways, those who, commencing at the car-brake, have risen to be the managers and superintendents of great lines of travel. These are the overflow, the surplus boys who had not room on the old homesteads.

If, then, this searcher after information will consult our most admirable State census, he will find that the population has more than doubled in less than forty years; that, in the past ten years, from 1875 to 1885, the population has increased nearly 300,000; that, since 1865, the cultivated acres have increased from 881,402 to 939,260, — 57,858 acres; that every county in the State shows an increased average value of land and buildings on farms in 1885 over 1875. Farms in the vicinity of the cities, with their increasing population, are greatly enhanced in value; and this is a large item, considering that forty years ago we had but four cities, and now have twenty-five, with people to be fed numbering in each from 15,000 to 400,000. The average value of farms, gardens, orchards and the buildings thereon, is each $4,112.83 for 1885, as against $3,660 in 1875, — or $452.83 gain on each farm.

The special importance and interest of this are enhanced by the fact that, in our system of farming, the Massachusetts farmer detests the relation of landlord and tenant; the former he seldom is, the latter he will not be. He will have his farm in fee simple, even if he has to temporarily embellish it with a mortgage; and the fact that many do that, and, by industry, economy and prudence, successfully throw off that burden, proves that even under those conditions farming can be made to pay. The opinion of practical farmers on this landlord and tenant question is shown by the fact that while the whole number of farmers is 40,112, there are but 3,243 of those as tenants. The whole number of persons engaged in agriculture in 1865 was 68,538; in 1875, 70,945; and in 1885, 77,661.

I find another evidence of the general prosperity of the farms, by the courtesy of the Secretary of State, who to my inquiry replies that the whole number of insolvent debtors returned to his office for the ten years past was 5,379, of which he is glad to say only 121 farmers appear in

the record, — about one-fifth of one per cent. I venture to say, that, if these could be traced, four-fifths would be found to have failed in transactions outside of legitimate farming, — such as signing notes for others, buying wild-cat patents, assuming obligations too heavy to carry, or attempting to combine with their farming some other business for which they were unfitted.

This certainly does not look like a decline in the agriculture of Massachusetts, and these facts stand in strong contrast to careless individual opinions and observations.

For years has gone out the cry of "Keep the boys on the farm." This *ad captandum* wail, largely the stock of careless lecturers and newspaper writers, uttered without consideration or sufficient reason, should be greatly modified. To induce one boy to remain on the old homestead — to comfort and assist the father and mother on the down hill of life; to care for the farm, and ultimately to become its owner and the head of a new family, with the social, domestic, business, political and religious responsibilities attending these — is a consummation devoutly to be wished.

But those who clamor to keep the boys on the farm do not thoughtfully consider the condition of the farmers and their farms, and still less from their narrow stand-point of vision do they consider the laws of nature, under the ordering of a Divine Providence, which compel the dispersion of these families sooner or later.

In the first place, see the situation of the farmer, his land and buildings, as commonly found The average size of farms is now about seventy-five acres; fifty years ago, about ninety-nine; and the average number of children in a family, about five. Now, to keep three or four boys on the same farm, when they had attained their manhood, with an instinctive and proper desire to be their own masters and to be husbands and fathers, would be unreasonable and impossible. A natural spirit of pride and independence would forbid their long continuing as mere wage-workers. The farm could not be made to support two or three families, even if they attempted the impracticable scheme of a cooperative system. It is not, in the ordinary experience of mankind, possible for two or three families long to dwell in

harmony under the same roof. If two or three grown brothers, with a father and families, ever passed together a continuous, pleasant and profitable life, it is very exceptional.

The attempts formerly made, — now happily rare, — of keeping the boys on the farm by its division among sons, the old father retaining only a life support, have too often resulted in unseemly and distressing quarrels. Quite as impracticable and impossible would it be to divide among two or three sons a farm of a hundred acres, — "suitably divided," as an advertisement would read, "into mowing, tillage and pasture, with wood enough for family use, a never-failing well, and running water to the barn." Manifestly, this could not be done; and the only way to keep boys on a farm would be for one to buy an adjacent property, paying what money he had earned since he was one and twenty, mortgaging the farm for the remainder, and getting the old man to sign his notes.

Now, arrangements being made for but one of the boys to stay on the farm, what is to become of the others, and of the sisters, who certainly are worthy of equal consideration, though they seldom receive it? They must go. So much for the practical and personal side of this question.

But there is another matter involved in this "keeping the boys on the farm," broader and more important, in a political sense. History shows that the permanent colonization, settlement and cultivation of new territory is always (with the exception of nomadic races, who move in tribes) accomplished by individual action of the young, hardy, restless and persevering members of the community. The promptings for this migratory tendency are various, never so well illustrated as in the history of our own State and of this whole country: "freedom to worship God;" the search for gold and other precious and useful metals; a desire for more genial skies and a richer soil, which should yield its abundance uncumbered with thorns and thistles, and unwatered by the sweat of the face; and a restless, adventurous desire to penetrate the unknown, and to see and to try something new.

But, were we of the Aryan race not thus possessed of this roving tendency, there would in time have come an

imperative necessity for a constant migration. While among our rugged mountain ranges there are fertile valleys and productive hill-sides, yet a limit would long ago have been found, where the productions of the soil would not have been sufficient to supply the wants of that greatly increased population.

Malthus, a great authority, says: "There is a constant tendency in all animated life to increase beyond the nourishment prepared for it. It is observed by Dr. Franklin that there is no bound to the prolific nature of plants and animals but what is made by their crowding and interfering with each other's means of subsistence. Were the face of the earth vacant of other plants, it might be gradually sown and overspread with one kind only; and, were it empty of other inhabitants, it might in a few ages be replenished from one nation only, — as, for instance, with Englishmen.

"The great law of necessity, which prevents population from increasing in any country beyond the food which it can either produce or purchase, is a law so obvious and evident to our understandings that we cannot for a moment doubt it. The different modes which nature takes to repress a redundant population do not indeed appear to us so certain and regular; but, though we cannot always predict the mode, we may with certainty predict the fact.

"In the northern States of America, where the means of subsistence have been more ample, the manners of the people more pure, and the checks to early marriages fewer than in any of the modern States of Europe, the population has been found to double itself for above a century and a half in less than twenty-five years."

The learned and accomplished superintendent of the Federal census says that the capabilities of increase in population have been exhibited, and on a vast scale, under the most favorable conditions for observation, upon the territory of the United States within the past century; and these capabilities are well understood and susceptible of reduction to at least approximate mathematical statements. In a new community, where land is abundant and fertile, where the occupations of the people are mainly agricultural, where the habits of the people are simple, and the absolute require-

ments of the family are few, a population of European stock may increase, decade after decade, at the rate of even thirty per cent in ten years; and it is even possible that, in circumstances exceptionally favorable, an increase of thirty-three or thirty-five per cent, wholly irrespective of immigration, might take place in ten years.

The entire immigration to the United States for thirty years, between 1790 and 1820, was estimated by Dr. Sybert at only about eight thousand annually; while the entire population had increased from four millions to nine and one-half millions.

Governor Winthrop, speaking of the increase of population to 1640, says, with the rate of increase going on for thirty-five years, the people would have multiplied more than fifteen fold before the beginning of King Philip's war, a doubling in about nine years, which ratio could not last long. The great increase which did come, and by comparison what it would have been, is made more comprehensible by the fact that, prior to King Philip's war, in 1646, forty-four towns had been settled and incorporated; and that before 1765, the date of taking the first colonial census, the number of incorporated towns had increased to one hundred and seventy-five.

This position is strengthened by the fact that, from 1701, when, by the best estimates that could be made, the population of Massachusetts was seventy thousand, to 1776 it had increased 402 per cent. Up to this time there had been but little migration either way; but soon after the war the growing surplus went West.

The redundancy of population in Massachusetts has been constantly reduced by migration to other States and the vast territory west, without which that immense fertile country would for a long time have remained in possession of the roaming buffalo and the untutored Indian. The agricultural portion of our population has in more recent years been somewhat relieved of its redundancy by occupations in local centres, in manufacturing towns or various railways.

The superintendent of the census of 1860 says that about one-third of those born in Massachusetts were then living in other States, and that the old agricultural States may be said to be filled up, so far as the resources adapted to a rural

population in the present condition of agricultural science may be regarded. The conditions of their increase undergo a change upon the general occupation and allotment of their areas. Manufactures and commerce then come in to supply the means of subsistence to an excess of inhabitants beyond what the ordinary cultivation of the soil can sustain.

But people who enter other occupations and pursue other industries must be maintained in food; they cannot live on the products of mechanical, manufacturing or professional labor alone; their actual support must come from the soil, — naturally, where they live. And when the land where they have settled fails to furnish that support which they need, they must seek it elsewhere, either by buying it from abroad, — not always practicable, — or, as in this case, migrating to broader and more fertile fields, from which to draw the means by which they live.

By the normal increase, without the addition of immigrants, the population of 378,787 in 1790, in doubling at the moderate rate of every thirty years, would have been 757,574 in 1820, 1,515,148 in 1850, and in 1880, 3,110,296, — a population of 386 to every square mile of territory in the State, exceeding in density every other State or country recorded, except Belgium, which has 481 to the square mile, but on over six million acres of cultivated land (five million in the highest state of tilth), while we have but 939,260 acres.

It is, therefore, evident that such a population could never have been maintained on such an acreage of such soil as our State; nor would even the subjugation of the million and a half acres of our "uncultivated land" have afforded relief.

It was only the migration from the farms of able-bodied young men and women, that both held in check our ever-increasing population, and planted in other sections of this wide land the germs of great States and a stable government.

While the laws of nature have forbidden any great advance in our agriculture by the ordinary increments of population, counteracted as they have been by constant emigration, we must turn to the remarkably full and accurate statistics of our own census, to judge somewhat by comparison of our standing at the present with that of former years.

For the last two decades, since 1865, we have very careful and minute tables; prior to that, for two decades, not so complete, but enough to make interesting, and, so far as they go, satisfactory, comparisons of the condition of our farming. In the first place, we are shown, as before stated, a gain in the past twenty years of 57,858 acres of land under cultivation. The increased value of farm property is similar.

Farms and Farm Buildings.

1865,	$153,084,565
1875,	182,663,140
1885,	185,118,925

All Farm Property.

1865,	$198,506,103
1875,	209,974,877
1885,	216,230,550

We are also shown, that, while (with the exception of corn, in which we hold our own) our crops of cereals have somewhat diminished, we exhibit a steady and large increase of all agricultural and domestic products in thirty years; back of that our returns are too incomplete to make any comparison.

Agricultural and Domestic Products.

1865,	$32,027,821
1875,	37,073,034
1885,	47,756,033

During the past forty years vast changes have occurred, altering our whole manner of living. By the construction of long lines of railway, the important staples of life, as the cereals and meats, which our climate and soil could not have furnished to our much more than duplicated population, have been brought to our doors, at rates lower than we could usually raise them with profit. But with the increase of consumers has come a great demand and a cultivated taste for many articles of necessary and luxurious food, formerly unknown or uncalled for, now supplied by farmers and gardeners.

Of fruits, berries, nuts, etc., we raise $2,680,000 worth. The whole product of fruits for 1845 was $755,382. Besides

over $1,100,000 worth of apples and $147,000 of pears, we grow over $540,000 worth of cranberries; of strawberries, over $400,000; other berries, $138,000; and of grapes, $117,000. Of vegetables we show $5,227,194, against $1,824,112 in 1845; quite credible, when, beside $2,000,000 of potatoes, $270,000 of onions and $500,000 of cabbage, we add $100,000 for asparagus, $154,000 for celery, $240,000 for green corn, $109,000 for lettuce, $164,000 for tomatoes, and for dandelions $55,067, — and thousands more for a host of nutritious and delicious esculents, which in earlier days generally graced only the tables of the wealthy, but now in their seasons are considered as necessities for the proletariat.

It is not only that the farmers live better than their fathers, but their surplus goes to the consumers, and from this come quick returns, by which they are able constantly to provide for themselves necessities and the comforts of modern living. This change of productions is most plainly illustrated in the fact that the value of the cereals now grown by us is less than that of the animal products, the dairy, or of fruits, berries and nuts, or of vegetables. The dairy products have increased from $1,800,000 in 1845 to $13,080,526 in 1885; and of this increase nearly $5,000,000 are within the past ten years, or since 1875. These figures show that the farmers of Massachusetts are not losing their importance; and that, while it is not a great farming State, it has its own features of farm industry, which, as displayed by our census, are valuable and encouraging. To a considerable extent the advance in agriculture is corroborated by the report of the town assessors, who represent the taxable real estate as very largely increased; and of the personal property, that horses have increased in number the past year 5,315; milch cows and other neat cattle, 9,686. Sheep, however, are still on the declining plane by 3,733, while their individual value has decreased from $4.38 to $3.83. Explanatory of this, to some extent, is the humiliating fact that dogs have increased 3,729 in number, and are returned by their owners as worth to them $12.05 each, as against $9 74 in 1875.

There is a large discrepancy between the assessors' report of swine and that of the census. In 1885 the assessors

return 44,670 swine; our census for the same year gives 65,749 hogs and 69,680 pigs. The only explanation I can give of this is, that on May 1, when the assessors make their lists, it is for the purpose of taxation, and nothing is returned beyond the extremest limit of the law. The grown hogs, except mainly breeding stock, have generally been slaughtered during the winter; and the pigs that came in the spring, or were farrowed the previous fall, had not, in the judgment of their owners, arrived at an age sufficient to undergo the rigors of taxation. But in the coming autumn, when cattle shows are blooming, and in November, when our State census is taken, to show the magnitude of our stock-growing, with no fear of an impending tax, the returns are made with the most profuse liberality; and, by that time, every pig that squealed in May has developed into shote-hood, and is recorded a hog. This may reasonably account for a large difference in the two enumerations.

A careless reading of the census for 1865 might lead one to think we had lost largely in dressed meats. No doubt the thousands of tons of dressed meats of all kinds, brought on in refrigerator cars, have reduced our production of beef, mutton and pork, but not to the extent which the incomplete census of that year would show, of over fourteen million dollars' worth of dressed meat, while we show less than three million in 1885.

In 1865 all the cattle, sheep and hogs, brought from abroad and slaughtered at Brighton, to the amount of over four million dollars, are credited to us; which in 1885 are properly omitted, as not our products.

Again, the price of dressed meats in the exceptional year of 1865 was just about double that of 1885, which would be about seven million dollars. These two amounts, with our actual production of nearly three million, about equalize, and show that our loss even in that line is comparatively insignificant.

Without going into any further detailed statements, I give below a table showing the increase in animals and products since 1845, — forty years. I take this date as of the earliest agricultural statistics collected by our State, and at a time when a dollar counted a hundred cents. I have taken all the

articles enumerated in 1845, — others could not be compared; and, from the different way of taking the census then and now, I have been obliged to group neat cattle, horses and colts, lumber, wood and charcoal, and the cereals.

	1845.	1885.
Neat cattle,	$5,327,199	$8,487,982
Horses,	3,451,118	6,055,143
Sheep,	556,284	265,952
Swine,	917,435	1,013,617
Wool,	335,136	61,432
Butter,	1,106,709	2,541,551
Cheese,	398,174	99,119
Milk,	304,907	10,515,468
Poultry and eggs,	51,782	2,070,462
Cereals,	2,228,229	1,805,177
Hay,	5,222,833	9,676,893
Potatoes,	1,309,030	1,904,225
Maple sugar,	41,443	77,175
Tobacco,	16,686	474,929
Beef,	225,918	493,014
Wood, charcoal and lumber,	2,379,911	2,602,953
	$23,872,794	$48,145,092

It will be seen that we have in forty years almost doubled in every product of the farm except sheep, wool, cheese and the various grains. Sheep and wool have gone to the dogs. The milk that was formerly made into cheese now goes more profitably to creameries, or to those who don't keep cows. Of corn, our royal crop, we grow more than we did forty years ago, but by the bushel the price is not so high now as then. We can import it from the West cheaper than it could have been grown at that time; and, with our improved implements and modern modes, we can raise it cheaper than we can import it. Wheat, rye and oats are grown in less quantities, as the land can be more profitably used for other purposes and crops.

The condition of our agriculture by the test of the census figures is very satisfactory. An impartial and quite satisfactory test for judging of the vitality of the agriculture of our State may be made by examining the exposition of its character, as manifested in the action of the people through the Legislature, in establishing and maintaining a Board of Agriculture, an Agricultural College, an Experiment Station prior to the action of the Federal government, and numerous agricultural societies, — all receiving the bounty of the State, in a liberal provision annually paid.

It cannot be questioned, that to the efforts of our agricultural societies is to be attributed in a great measure the general advancement of practical agriculture among us. They have encouraged by premiums and stimulated by honorable competition; they have excited greater interest in the objects of agricultural labor, diffused information respecting it among the people, and elevated the standard of good husbandry.

It has been often printed, and commonly believed, that the first cattle show and fair ever held in this country was at Pittsfield, in Berkshire County, in 1814. While this is true as of a "cattle show" for the exhibition of stock, for that merely and for premiums for the best, yet, for early activity in a united effort to advance agricultural interests in this State, the town of Hardwick, in Worcester County, is the first.

June 12, 1762, was passed "An Act for setting up a Fair in the Town of *Hardwicke* in the County of *Worcester*."

Be it enacted by the Governor, Council *and House of* Representatives, That henceforth there may be kept a Fair in said *Hardwicke*, on the third Wednesday and Thursday of *May*, and on the third Wednesday and Thursday of *October* annually.

And be it further enacted, That the said Town of *Hardwicke* be, and hereby are, enabled at a Meeting called for that Purpose, to chuse proper Officers to Regulate said Fair, until the annual Meeting in *March* next, and to be chosen thereafter annually in the Month of *March* during the Continuance of this Act.

And be it further enacted, That no Bargain and Sale made at any of the said Fairs, shall be deemed valid and effectual in the Law, unless the same be made between Sun-rising and Sun-setting.

This Act to continue and be in Force for the Space of seven Years from the first Day of *July* next, and no longer.

This fair was held for many years, the charter having been extended, and was so important and of such general interest that its occurrence was duly heralded by the almanacs of the day, and "Hardwicke fair" had as conspicuous a notice as "general election," or "Commencement at Cambridge." It attracted public attention, and multitudes flocked to it from all the regions round about. It was uniformly under the direction of a superintendent, clerk, and from two to four constables, elected at the annual town meeting.

This fair was instituted largely by the exertions of Brigadier-General Ruggles, who for twenty years resided in Hardwick, and was very active in promoting the welfare of the town by introducing improved breeds of horses and cattle and better methods of cultivating the soil. Unhappily, he did not believe that the severance of the provinces from the mother country, at that time, was desirable; and, after suffering all the insults and indignities put upon Tories of that day, he openly and defiantly left the town and the country. His great farms, five in number, were confiscated, and he, at the age of eighty-eight, died in Nova Scotia after the war was over, having been by George III. somewhat compensated for his loss of property and station, and for his loyalty to the Crown.

Soon after the close of the Revolutionary War, in which our success freed us from the restrictions which Great Britain had placed on our trade, commerce and manufactures, many of the leading men of Boston, — professional, merchants, mechanics, ship-owners and others, — foreseeing in the growth of this new country the necessity of early promoting its agriculture, from which all future prosperity must necessarily flow, obtained from the general court in March, 1792, an Act incorporating the "Massachusetts Society for Promoting Agriculture."

The simple preamble reads: "Whereas very great and important advantages may arise to the community from instituting a Society, for the purpose of promoting Agriculture; and divers persons having petitioned to this Court to be incorporated into a Society, for that laudable purpose; Be it therefore enacted," etc.

The twenty-eight incorporators bear the names of the

most patriotic, prudent and respected citizens of their day, whose record is not only perpetuated on the books, but in the streets, places, buildings and public institutions of this our capital; and of many of them their memory is kept everlastingly green in the names of various beautiful towns through the Commonwealth. They commenced with a subscription among themselves of four thousand dollars, — a liberal sum for those days. Since, by annual assessments, by legacies and donations, the society has accumulated a large sum, the interest of which has from the first been expended by them for the benefit of the farmers of the Commonwealth, for whom it has done more than any other society, or than all combined.

In 1797 it instituted the "Agricultural Journal," a publication continued more than thirty years. It took measures for the institution of county societies, and erected a hall at Brighton for the exhibition of domestic and agricultural products. It contributed to the establishment of the professorship of natural history and of the botanical garden in the University at Cambridge. It originated a series of addresses at agricultural exhibitions, from the most eminent men, which were published and distributed with great effect and influence. It paid handsome premiums for essays on agriculture, and for experiments, and for successful crops and how to grow them. It imported and distributed through the Commonwealth the first of the finest breeds of all our best domesticated animals, vastly to the improvement of our stock, and help to the farmers.

The Berkshire County Agricultural Society, incorporated in 1811, was the next, and held, at Pittsfield, the first cattle show in this country, in 1814. The Society of Middlesex Husbandmen, started in 1803, was incorporated in 1820; then followed the Hampshire, Hampden and Franklin, the Worcester and the Essex, in 1818.

An Act of 1819 appropriated two hundred dollars annually to every society which should raise the sum of one thousand dollars for the promotion of agriculture, and in like proportion for any greater sum, not exceeding three thousand dollars. Since then, so great has been the interest in agriculture, and so liberal the State in continuing its

aid, that now no less than thirty-four incorporated societies hold their annual fairs, their farmers' institutes and farmers' clubs.

In 1852 the Board of Agriculture was established, the members of which are the Governor, Lieutenant-Governor, Secretary of State, the President of the Agricultural College; three members at large, appointed by the governor, and one from each incorporated agricultural society.

The Agricultural College, under the combined action of the Federal and State governments, was incorporated and located at Amherst in 1864. It has been, and still is, very successful, — never so much so as now. The Experiment Station was also incorporated and located at Amherst on the grounds of the Agricultural College, in 1882, and now receives support from the Federal government.

Under the direction of the Board of Agriculture, each incorporated society holds not less than three farmers' institutes during the year, for essays and discussions.

In 1864, in accordance with the views of the Board of Agriculture, expressed the previous year, the New England Agricultural Society was formed, comprising in its limits the six New England States; and has in each year, in some one of these States, held a large and successful exhibition, in which were represented great agricultural, manufacturing and mechanical displays.

The Bay State Agricultural Society was organized in 1886; and, as a society bearing the name of the State, and as an exponent of the agriculture of the State, may properly receive a somewhat more extended notice.

There is no doubt that the early exhibitions of the State and the county societies of Massachusetts contributed very much to the improvement of our practical farming, and much to awaken a spirit of inquiry and investigation; and that their continuance will do more than any other one thing to secure the advancement of agriculture among us.

The Massachusetts Society for Promoting Agriculture continued its exhibitions for more than twenty years, and until they were found to interfere with those of county societies; they were then abandoned in 1833, and the funds of the society devoted to the importation and breeding of stock, distributed all over the Commonwealth.

More than twenty years then passed, and meanwhile, as most of the neighboring States had adopted the practice of holding State fairs, it was thought by some farmers, especially in the western part of the State, that the interests of agriculture would be served by holding a State fair in Massachusetts. Accordingly, a meeting of citizens to consider the matter was called at the State House in July, 1857, when the matter was discussed at length. It was finally voted that a State fair should be held whenever the State Board might deem it expedient. It was determined by that body to hold a fair in Boston, October 20–23, late enough not to interfere with the county societies

The weather was very cold, discouraging visitors, and the time happened unfortunately in the midst of an unexampled financial crisis, so severe that many of the wealthy gentlemen subscribers to the guarantee fund trembled as they rose in the morning, lest the night should close upon their ruin. The fair, interesting in the display of animals and of products, was not a success financially, notwithstanding that the Massachusetts Society for Promoting Agriculture made the very generous donation of two thousand dollars.

The attempt was not renewed, and the matter of a State fair slumbered for nearly thirty years; till, in September, 1885, some spirited men, mostly from Worcester County, feeling that the New England society now twenty years established did not meet the requirements of an exclusively State society of Massachusetts, resolved to again make the attempt to form a society, and to hold a fair. A public meeting was called at Worcester, and quite largely attended, when it was voted to form a State society, to be called the Bay State Agricultural Society. April 19, 1886, a charter was obtained, under the general law of corporations, a constitution and by-laws were adopted, able and efficient officers chosen, and in Boston, Oct. 5–9, 1886, a fair was held, with great success, in the grand display of animals, financial results, and the instruction and enjoyment of thousands.

Greatly to the disappointment of farmers and many other people, the prevalence of epizootic pleuro-pneumonia in various sections of the country made the holding of a fair, as was intended the next year, unsafe, and it was passed till

1888 At the solicitation of many farmers from the country, especially from the western part of the State, and great assurances of a very large attendance, with a sufficient guarantee fund from citizens of Springfield, the second fair of the Bay State Agricultural Society was held on Hampden Park in that city, commencing on October 4, and continuing a week, — rather against the judgment of the officers of the society.

The grounds were admirably adapted and arranged, with abundant water, and with ample, convenient and securely enclosed sheds for the accommodation of the vast collection of animals, and the comfort of their keepers. Every preparation for a great display of fine animals and a very large

during the whole week was exceptionally bad, — cold, cloudy, raw, with rain almost every day and night, with an occasional snow-squall. Aside from the inclement weather, I am inclined to think that these two experiences settle the question of expediency in holding a great and expensive fair in a large city, or in the country, in favor of the city.

If the farmers, with their wives and children, wish to see the fine animals, — for comparison, for education, for purchase or for the pleasure of sight-seeing, — they might just as well come to Boston, and take a holiday, as they do Arbor Day, Decoration Day, or Labor Day. While, of the residents in the city, there are ten times as many, paying ones of all classes, to whom the sight of these fine animals is as a new revelation, and who will derive from their visits to the fair an immensity of instruction and amusement, and the teaching of the fair would be by no means lost.

While some of the grandest animals were from beyond the limits of our State, yet there were enough of the splendid

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ERRATUM.

Page 349, second paragraph, tenth line, *for* $30,000, *read* $3,000.

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The grounds were admirably adapted and arranged, with abundant water, and with ample, convenient and securely enclosed sheds for the accommodation of the vast collection of animals, and the comfort of their keepers. Every preparation for a great display of fine animals and a very large attendance of people was made by the officers of the society and the citizens of Springfield, in the most liberal manner. The animals were there, the finest collection we have ever had in Massachusetts, but the people did not come; and the pecuniary loss was about $10,000, of which $30,000 was supplied from the surplus of the first fair at Boston, and $7,000 from the guarantee fund of Springfield.

One reason for the discouraging want of success in the scant attendance was doubtless owing to the weather, which during the whole week was exceptionally bad, — cold, cloudy, raw, with rain almost every day and night, with an occasional snow-squall. Aside from the inclement weather, I am inclined to think that these two experiences settle the question of expediency in holding a great and expensive fair in a large city, or in the country, in favor of the city.

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While some of the grandest animals were from beyond the limits of our State, yet there were enough of the splendid

productions of our own growing to make us proud of our Bay State fair, and of the substantial evidences of our farming. My conclusion is, — seeing the general solvency of the farmers, and regarding individual expressions derogatory to the general prosperity of the farmers as misleading and incorrect; and thinking that the establishment and perpetuation of our agricultural institutions by the Legislature of the Commonwealth is convincing evidence of the confidence of the people in sustaining a necessary and reasonably prosperous occupation, — that all these, with a scrutiny of the figures of our census, show unmistakably a great and substantial progress in the agriculture of the State, and in the condition of the tillers of the soil.

A HUNDRED ACRES OR MORE.

BY ELBRIDGE CUSHMAN OF LAKEVILLE.

Our forefathers, while in old England, learned to place great value upon land. Limited in their possessions, with no hope of becoming land-owners, they realized the full force of the old couplet, —

> "Time was, ere England's grief began,
> When every rood of ground maintained its man."

It would have been strange, indeed, when landing upon what to them seemed the boundless shores of an unoccupied wild, if they had not exulted at the possibility of unlimited ownership of land.

As the years went on, and their numbers increased, this greed for land took deeper and deeper root in their natures, and we find in the earlier records of the colony an account of some of the boldest "western land speculations" that are recorded in the history of our country. Within a few years of their landing, large tracts were bought of the natives, which, in many instances, are still known by the local name given at the time of purchase. This ruling passion was strong in death. Wills, bequeathing land to sons, often contained a request that it should be retained by them until transferred, without division, to male heirs, or to brothers of the same name. Thus large tracts of land were held in the same family name for several generations. No doubt the old-time customs would have continued until our day, had not the conditions changed, bringing with the changes new customs and ideas. The demands upon the public treasury were increased by the organization of Christian and educational institutions, and by the cost of the various im-

provements made by public enterprise. Taxation increased and bore heavily upon the land-owners. By the wonderful development of the resources of the country, and the rapid increase of new industries, the price of farm labor was advanced faster than the price of farm products was increased, and the New England farmer was surprised to find that he had become "land-poor." Just prior to the middle of the present century a reaction commenced, and many were found heartily responding to the sentiment, "Ten acres enough." It was thought that a small farm, well tilled, would prove the paradise of the husbandman. The day-dream of the laborer of every trade seems to have been of a little home in the quiet country, with a few fertile acres to be tilled by his own hands. Many stories were told of fabulous profits realized from single acres devoted to special crops, far exceeding the income from farms containing many broad acres. Science was demonstrating the possibilities of an extensive system of farming. The benefits of such a system were, however, necessarily confined to lands adjacent to the cities and larger towns, while the homesteads that dotted the mountain sides, as well as those down by the sea, were truly left "out in the cold." Many could not realize these changes, so gradual, yet so sure. They did not try to adapt themselves to them. Numbers of New England farmers wore themselves out struggling in this contest with the inevitable. So here, as in many another instance, it has been only through the agony of death itself that the new ideas and systems have been able to supplant the old. As time has passed, many of these old homesteads have been left untilled and some are quite deserted. The lilac, the lily, or the garden rose may yet mark the spot where once centered the hopes and affections of a happy family; where comfort, peace, and hallowed associations once clustered around a home. And yet this was one of a neighborhood whose people were all like the Arcadian farmers, —

> "The richest were poor,
> And the poorest lived in an abundance."

But a new era has dawned; other rapid and mighty changes are in progress. The last quarter century has witnessed a

most wonderful development in art and science. The laws of trade have been almost revolutionized. Within our memories some of the States of this Union were practically more distant from us than are to-day the most remote countries of the earth. Our tables are supplied with the luxuries produced in distant lands, and they are cheap in comparison with the fruits of our own State and neighborhood. The small producer finds his products forestalled in his own home market by those from warmer climes, cheaper lands and perhaps cheaper labor. Large profits are no longer possible, and his little business, once so pleasant and profitable, will hardly meet the expenses of his family. The interest and taxes on his high-priced land are serious burdens. It has been said that land valued at over one thousand dollars per acre cannot be profitably farmed in Massachusetts. The same would be only too true of land of much less value if it were used for farm crops and common market gardening. There is abundant evidence that the profit on the special crops of our market gardeners has been crowded down to a minimum by sharp competition, while in the purely farming districts there is a handwriting upon the wall that requires the help of no prophet to interpret, "Farming don't pay."

We learn with sadness from statistics that the value of our farms is depreciating at the rate of over half a million dollars per year, while in some towns almost whole neighborhoods are for sale, and miles square can be bought for less than the cost of improvements. No farmer can contemplate this state of affairs without extreme solicitude. We do not mention these facts to excite alarm or to discuss causes, but rather for the purpose of suggesting remedies. We do not belong to the desponding class. We have great faith in, and high hopes for, the future of New England agriculture. Our only fear is that the farmers will fail to grasp their opportunities in time. Men of small mold and contracted mind have had their day in all vocations. They are being crowded off the stage. The present condition demands men of broad views and energetic habits. The successful farmer of the future will be a man of such a stamp, — a thinking man, a man of broad and comprehensive ideas. He will be compelled to compete with the world, so he will draw information from

every source. He will not confine his search for the secrets of success to the operations of those engaged in kindred pursuits. He will early learn that agriculture is not an exceptional business, but that it is subject to the same laws of trade that other callings are, and that the same causes lead to success or failure in all vocations. He will see that the most successful producer is the one that can place his product before the consumer for a trifle less than any competitor, and that where the profit on a single article is but a trifle, quantities must be produced to insure an income.

Not long since we were told by a successful manufacturer that he commenced business twenty-five years ago with small capital and little knowledge of the business. At that time, the profit on a five-thousand-dollar business gave him a fair income; now, with a business ten times as large, it requires all the skill that years of experience have brought to insure only the same net income. This is not an exceptional case. In our fathers' day, the shoe-maker pounding his leather on his lapstone and pegging his shoes upon his knee completed one pair of shoes per day, and sold them at a living profit. To-day, he who would make shoes at a profit must employ powerful and costly machinery in large shops. He will be able to tell you the number of pairs turned out per second in his large establishment. Trades have been divided and subdivided until a score or more are embraced in one. Each of these has become a specialty, and successful men in every industry are known as specialists. Are these lessons not to be noted by the farmer? Can the novice without experience or capital hope to compete successfully with the expert having all these advantages? Can the stranger in the market expect his mite of production to receive notice beside that of large producers in charge of sharp and experienced salesmen? The inevitable conclusion is, that the "hand-to-mouth" "one-horse farmer" has had his day. Starvation, if nothing else, will force him out of the business. Already the farms of Massachusetts have increased in size until the average is nearly or quite ninety acres each. This indicates progress, and is in keeping with the changes in nearly every industry. Consolidation, concentration, combination, are the unmistakable tendencies of

the future. We would by no means discourage the acquirement of small homesteads. The ownership of a farm is conducive to good citizenship, and we would that every man, whatever his calling, might own the home that shelters his family; yet we believe that in the future the most successful farming of our State will be upon farms larger than the average. The products of these farms must depend largely upon circumstances and conditions of a local nature. Character of soil, demands of the local market, the taste of the farmer, should all be consulted. Then we must remember that the larger the business the broader and more comprehensive must be the ability of the manager. Science has already taken the place of luck and chance in the management of agricultural operations.

Our fathers often considered the phases of the moon, but the farmer of the future will note the conclusions of our experiment stations and the warnings of the weather bureau. His efforts must be special rather than general. The successful farmer will be a specialist, and will need a thorough training in the branch he undertakes. Our State is placing golden opportunities within the reach of every boy who has a taste for agriculture. All that is required on his part, to fit him for the highest position in his calling, is ambition, perseverance and industry. One who has the scientific training of the schools, combined with experience in the field and on the farm, will always be sought after. The demand for such men already exceeds the supply. The field is broad. Capital stands waiting for a directing hand. It has been said, with truth, that a president for a railway corporation, or a captain for a large ship, can be more readily found than a man capable of the management of a large farming estate. We believe that the boys who will help supply this demand are already in our schools. It is not the part of wisdom for the Massachusetts farmer to despair, or sit down in idleness because the products of other sections are sold in his local market. He should bestir himself at once to produce a better article, or endeavor to supply the demand at a less price than it can be obtained from abroad. Most of the land of our State can be made available for the production of something needed by our own

population. In some sections grazing would seem to be the most profitable. Sheep husbandry and dairying will be followed by farmers in such localities; other sections are adapted for fruit-growing; and under the constant care of one experienced, the business may be made a financial success. Perhaps nowhere in the world are the choice grasses grown to greater perfection than in our State.

Science and experience alike have demonstrated that good crops of hay can be grown for many years in succession without the application of animal manures. Some of our lands are well adapted to the production of cereals. In the present state of the market the business would be close and the profits very small; but with skilled hands, sustained by the necessary capital, so that every discovery in art and science might be utilized for assistance in the work, we are confident that the profit realized would equal that from the same amount of capital invested in trade or manufactures. We have been for some years somewhat extensively engaged in the production of Indian corn. From careful observation we know that the cost of production has been enough below the market price to afford a fair profit. But, to accomplish this result, large fields have been cultivated by machines and horse-power. Plant food has been supplied in the cheapest form known. The experience gained in the work has taught us that the cultivation of the single acre without the aid of suitable helps is done at a loss.

We believe a greater confidence and a closer relation between capital and labor are needed in our calling. Young men should conquer their aversion to farm work, especially in subordinate positions. The old maxim, of "learning to obey before attempting to control," should not be forgotten. We believe it to be quite as lucrative, and fail to see why it may not be quite as honorable to be employed as foreman or laborer on a large estate as in a factory or counting room. Great business ability and enterprise is being put forth in extending the varied industries of our State. Capital is abundant and cheap. There is within our borders much cheap land. Already we hail with joy the dawning of the day when skilled labor, business ability, enterprise and cheap land, together with capital, will place agriculture in

the front rank among the occupations of our people. The farmers are giving more particular attention to the conditions which are essential to success. Most gratifying results have already been achieved through the wider diffusion of knowledge, and the keener perception of opportunities.

In the future the Massachusetts farmer will feel no sacrifice of independence or individuality in consenting to become a simple part in the harmonious working of a perfected system. The liberal appropriations in aid of agriculture, and the good seed sown by the press and the schools, have borne fruit. Agriculture has become an acknowledged science. The business is now on an elevated plane, demanding in its management superior talent and energy. Soon organized capital will assist in its operations, and it will be conducted with the same system and certainty of success as the other industries of the Commonwealth.

MARKET GARDENING.

BY W. W. RAWSON OF ARLINGTON.

Market gardening should be distinguished from farming. While the market gardener is a tiller of the soil, his occupation differs essentially from that of the farmer.

By market gardening is meant the raising of such vegetables as celery, lettuce, cucumbers and the like, with a few of the more stable and hardy characters, such as squashes and beets.

The business of market gardening has within the last twenty years become one of considerable importance, and when understood is quite profitable. In this business, as in every other, the success depends more upon the man conducting it than upon anything else.

He must understand the nature of growing plants; the different qualities of soil required for each; the mode of cultivation and the time of planting best adapted to the climate where located. He must have some knowledge of chemistry and botany, must be a practical engineer and mechanic, and also be familiar with the laws of nature. After these requirements, the more common sense he has, the better for him.

The location of the garden is quite important. It should be as near the market as possible. If the roads to and from the market are level, the land will be much more valuable, because one of the largest items of expense in connection with the business is the teaming of the product, and the manure necessary to secure a crop.

The land should be of various qualities, and a gentle slope to the south and west is much preferable, because on it the crop will mature earlier, and it is easier to irrigate it. Near-

ness to a river or pond would be advantageous, because from it a supply of water could be obtained. If not near a river or pond, then a well could be driven which would answer the purpose. The possession of these would add value to the place. Ten acres well irrigated are worth more than twenty acres without irrigation.

The use of glass has also become very important in connection with growing crops of this kind, and many of the largest crops are grown almost entirely under glass. Hot-houses and hot-beds are used. The heat in the former must be furnished in cold weather by steam or hot water; in the latter, by hot manure.

The man who undertakes this business must serve an apprenticeship of several years, in order to become familiar enough with it to enable him to carry on a market garden, either for himself or for any one else, successfully.

I have had many come to me and say that they would like to work for me a year, that they might become familiar with the business, or, in other words, learn the trade.

I have told them that that would not be long enough time, and that five or six years would be little enough.

There is no class of men at the present time for which there is so much demand as for market gardeners, and at better wages than they could command in any mechanical or professional pursuit, with the same time spent in fitting themselves for their calling. It is a very healthy business. There is great variety in it, and something is constantly coming up that is new, and which will demand study and earnest attention.

I have followed it for twenty-five years, and have been unusually successful; yet I feel that I have many things to learn, and that the business is at present but in its infancy.

It is but a few years since hot-beds were introduced, and but ten years since hot-houses were first used. They were first heated by hot water, and later steam was used. Then it was learned that irrigation would be a great benefit; and now the electric light is coming into use. I believe that it has not only come, but that it has come to stay, because of the very great benefit it will be in the growing of our kind of crops during the short days of winter. It will be a very

profitable investment to all who will use it. I have one large light of 2,000 candle-power over one of my houses, and ten 30 candle-power inside another house. The effect has been very manifest, and the result of the experiment very satisfactory to me. I could see the effect upon the growing crop very soon after the lights had been placed in the houses.

I think I prefer to have them all inside the houses, and placed about twenty-five feet apart in a house twenty-four feet wide; the house would then be almost as light as day. The great objection to a light outside is that in frosty weather the light could not shine through the frosted glass, and it would therefore be of but little benefit, but when placed inside it has all the chance possible.

I cannot tell at present just how much benefit the light is, but by another year I shall have had it thoroughly tested.

The market gardener has many difficult problems to solve and but very few things in his favor. The weather is quite an important factor: but this is uncontrollable and we cannot find a substitute or a remedy. First-class help is hard to find; good land is difficult to obtain, all of it being occupied; the South is competing very closely with us; it is a constant struggle from beginning to end, and from morning to night. Unless the market gardener is in love with his business, it will be very discouraging.

In market gardening, as in every other branch of business, if one would carry it on successfully he must have special men for special work, and this can only be done by one who does sufficient business to enable him to employ a head for each department. In a mercantile establishment each member of the concern has a special part of the work to perform, and devotes himself to it exclusively. Each department has a head, who is held responsible for its success.

In mechanical establishments the same plan is adopted and the same responsibility is placed. In the professions we find that individuals are applying themselves to specialties. It must be so if success is to be achieved. In carrying on a market garden, I say employ a superintendent, a salesman, a green-houseman, a foreman for each department; a night-man to attend the fires in winter, and to keep an eye on the whole place; a machinist to look after the machinery and

tools; a painter to keep wood-work from going to decay and to keep the glass in repair; a hostler to take special care of the horses; a harness-maker to look after the harnesses and to keep them in repair, and to keep the horses from having sore shoulders in summer, etc.; a man to put up or to see to the putting up of all the vegetables that are going to market, so that they may always be put up uniformly and in a salable condition, so that your first and second qualities may run always the same, and the trade may know what to depend upon. Always select for a driver of the teams one who is adapted to it, so that the most may be obtained from the horses with the least wear upon them.

The selling of goods is not so difficult as in former years. Large quantities are now sold where but a little was sold a few years ago. The market gardener near a large city can dispose of large quantities of vegetables of many kinds if the quality is first class.

Sometimes the prices realized are quite small, but where they are raised in large quantities the cost is much less than it was twenty years ago.

The sales are all for cash, and in this respect it is one of the best kinds of business carried on. If the market gardener has a load for market every day, there is money constantly coming in, and he has ready money to pay his bills after he once gets started.

The cultivation of the soil is a very important matter to be understood. It requires much experience to know when to plant and how to plant. The selection of seed is also a very important matter. Success in this direction can only be obtained by carefully looking ahead, and by making the selections in the early part of the winter. You must know just how much is wanted; but always buy enough.

Before I went into the seed business I bought a great many seeds. My plan was to go to some reliable dealer, and tell him just what I wanted. I asked for the best, and always paid the highest price, so I was reasonably sure of getting the best. I fared much better than if I had spent my time looking around to find where I could buy the cheapest. You will find that, if you will always look for the best, the best will always be looking for you, and the man

with whom you deal will, if he has something extra nice and knows that you want it, send you word or save it for you. Follow this rule in relation to seeds and you will find that you will come out a long ways ahead. I have bought as high as $1,000 worth of seeds in one year, and I have never been cheated by a seedsman. I have paid the highest price and have felt that I have received my money's worth. The tools upon the market garden should be the best and of the most approved pattern. They should be kept in perfect order and in a building expressly for the purpose.

A plan of the place should be marked out early in the winter, and it should be definitely settled what crop is to be put into each piece the following season. This will enable you to get the manure into position,—the different kinds for the different crops. Estimate the quantity of seeds required by the size of the piece to be planted. Look the tools over carefully and have them put in the best of order. Do everything that can be done before the ground opens.

With the work all planned, the seed bought, the manure in place and the tools all ready, you can go to work, and in the busy time of planting you will appreciate all that has been done in the winter, you will be able to keep up with the work, and you will see how important it is to get everything ready, as I have described.

I would therefore advise young men who are thinking of taking up the market gardening business, to carefully study the requirements and then fit themselves to fill them. By following the suggestions I have offered they will be fitted to carry on the business with satisfaction and profit. Some may ask: How can the necessary education be obtained? I would say to them: Complete your grammar school course, spend one or two years in a commercial college, go to the Agricultural College, and after that course is completed, spend one year in the Experiment Station. Then engage yourself to the best market gardener you know of who will take you for three or five years. Then you will be fitted to take a position as a foreman, or you can carry on the business for yourself.

Some may ask: Are there any positions for young men with the education you have described? I will say that there

are, and I have some waiting to be filled at the present time, and can find no one to take them. There is a good salary waiting the position for the right man. This business is in the advance line of agriculture. It has never been brought to the notice of agriculturists as it should have been, but it is now, or soon will be, in the front, even though it is but in its infancy. It is that kind of a business that requires special training and a practical knowledge to secure satisfactory results. The amount of capital required is quite large, but not more so than is necessary in other lines of business carried on at the present time.

The profits, if carried on on a small scale, will not be so great as if carried on on a large scale, and they are not so great as a few years ago.

By starting small, giving close attention, and keeping the business on a pace with the times, the capital will be readily obtained. Only those will succeed in any business who attend to it, and, as we learn in the Scripture, "only those who endure to the end shall be saved."

THE FINANCES OF THE SOCIETIES.

FINANCES OF THE SOCIETIES.

SOCIETIES.	Amount received from the Commonwealth.	Income from Permanent Fund.	New Members and Donations.	All other Sources.	Receipts for the Year.	Premiums offered.	Premiums and Gratuities paid.	Current Expenses for the Year, not including Premiums and Gratuities paid.	Disbursements for the Year.	Indebtedness.	Value of Real Estate.	Value of Personal Estate.	Permanent Fund.
Amesbury and Salisbury, . .	$367 85	$100 82	$126 00	$1,075 72	$1,670 39	$875 00	$396 30	$82 00	-	-	-	$300 00	$2.397 31
Barnstable, . .	600 00	16 00	425 75	1,764 35	2,806 10	1,425 25	1,003 25	1,799 02	$2,802 27	$300 00	$6,000 00	-	6,700 00
Bay State, . .	-	-	1,787 00	27,228 71	29,015 71	11,568 00	7,453 00	-	-	-	-	-	-
Berkshire, . .	600 00	971 36	622 00	4,453 94	6,647 30	4,024 00	3,424 75	2,026 27	6,515 01	6,500 00	12,833 75	132 29	12,833 75
Blackstone Valley,	600 00	-	61 50	1,084 15	1,745 65	858 50	655 50	792 46	1,447 96	400 00	3,000 00	200 00	3,000 00
Bristol, . . .	600 00	-	371 25	11,767 52	12,738 77	5,500 00	3,584 33	6,838 77	12,423 11	18,000 00	30,000 00	500 00	-
Deerfield Valley, .	600 00	-	166 60	1,324 54	2,091 14	840 00	715 25	725 89	1,366 72	-	8,000 00	1,450 00	9,450 00
Eastern Hampden,	600 00	-	143 60	855 92	1,599 52	1,479 75	1,036 13	523 45	1,559 58	850 00	7,000 00	-	7,000 00
Essex, . . .	600 00	791 60	126 00	954 99	2,573 59	3,500 00	1,566 50	1,163 11	2,769 93	-	5,000 00	1,000 00	18,303 05
Franklin, . .	600 00	31 00	145 00	1,867 64	2,643 64	1,286 25	919 60	1,731 57	2,847 17	-	6,000 00	1,005 00	7,000 00
Hampden, . .	600 00	-	-	63 94	663 94	-	-	321 35	321 35	-	-	-	-
Hampshire, . .	600 00	-	101 54	433 39	1,134 93	87 40	614 27	520 66	1,134 93	1,129 63	4,100 00	150 00	3,200 00
Hampshire, Franklin and Hampden,	600 00	286 54	59 00	1,795 33	2,741 47	1,139 00	797 50	1,793 88	2,733 96	5,138 00	8,800 00	147 31	8,947 31
Highland, . .	600 00	-	41 00	948 11	1,589 11	818 05	603 70	985 09	1,588 79	235 00	3,000 00	100 00	3,100 00
Hillside, . . .	600 00	-	241 81	591 81	1,433 62	730 00	688 30	745 32	1,433 62	300 00	4,487 99	132 89	4,187 99
Hingham, . .	600 00	-	183 75	8,519 23	8,702 98	1,875 30	617 07	1,611 08	9,031 22	3,000 00	20,000 00	2,000 00	22,000 00
Hoosac Valley, .	600 00	-	489 00	4,253 54	5,342 54	1,831 50	1,368 00	2,582 23	5,305 36	1,000 00	12,900 00	450 00	14,350 00
Housatonic, . .	600 00	2,118 60	184 00	3,739 84	6,642 44	3,785 00	3,102 00	3,760 18	6,862 18	913 31	8,500 00	1,349 66	9,849 66
Marshfield, . .	600 00	-	371 53	2,454 80	3,426 33	1,574 00	1,172 91	2,044 44	3,302 35	4,500 00	11,806 92	1,392 78	7,306 92
Martha's Vineyard,	600 00	85 31	18 00	299 40	1,002 71	778 75	612 55	192 16	804 71	-	2,200 00	1,150 00	3,350 00
Massachusetts Horticultural, . .	600 00	1,100 00	490 00	29,841 00	32,031 00	6,000 00	6,268 00	23,132 00	29,400 00	37,000 00	250,000 00	42,233 00	220,000 00
Middlesex, . .	600 00	-	101 00	885 86	1,586 86	1,822 00	984 00	620 28	1,604 28	22,100 00	15,000 00	-	1,600 00
Middlesex North, .	600 00	-	35 00	1,159 59	1,794 59	1,195 50	773 93	1,111 05	1,763 75	2,250 00	20,000 00	150 00	20,000 00
Middlesex South, .	600 00	-	38 95	2,245 11	2,884 06	809 35	731 95	1,417 45	2,116 55	6,500 00	15,000 00	-	15,000 00
Nantucket, . .	600 00	65 00	41 50	1,337 56	2,044 06	1,315 50	609 00	507 98	1,175 03	100 00	3,000 00	200 00	3,200 00
Oxford, . . .	-	-	1,960 00	1,496 79	3,456 79	1,058 00	741 26	2,386 60	3,127 86	1,200 00	3,800 00	728 00	3,328 00
Plymouth, . .	600 00	300 00	2,772 40	4,148 76	7,821 16	3,515 50	2,201 54	5,606 08	7,807 62	6,990 46	43,000 00	2,000 00	45,000 00
Spencer, . .	-	-	5,061 08	6,466 59	11,527 67	1,428 25	870 00	395 28	9,997 95	4,200 00	7,000 00	850 00	7,850 00

Union, ...	600 00	-	90 00	2,281 54	2,971 54	1,620 50	1,082 32	961 23	2,043 55	-	7,270 78	2,460 88	9,731 66
Worcester, . .	600 00	1,582 03	625 00	23,694 88	26,501 91	10,929 00	9,253 09	14,763 96	24,017 06	46,000 00	130,000 00	3,361 50	84,000 00
Worcester North, .	600 00	-	301 60	3,290 49	4,192 09	1,363 20	1,209 60	2,542 78	3,905 98	-	4,000 00	1,109 99	5,109 99
Worcester North-west, ...	600 00	-	75 00	2,803 53	3,478 53	2,443 50	1,671 41	2,029 87	3,701 28	900 00	13,000 00	588 42	12,688 42
Worcester South, .	600 00	-	120 00	5,061 20	5,781 20	2,886 00	2,230 50	3,988 12	5,947 60	1,500 00	17,300 00	1,330 70	17,130 00
Worcester West, .	600 00	1,398 72	25 00	5 09	2,028 81	1,538 60	1,128 20	892 97	2,021 17	-	11,600 00	1,000 00	12,600 00
	$18,367 85	$8,846 98	$17,400 86	$160,194 86	$204,312 15	$81,930 65	$60,085 62	$90,594 58	$162,879 90	$171,006 40	$693,599 44	$67,472 42	$600,214 06

PERMANENT FUND.—HOW INVESTED.

AMESBURY AND SALISBURY. — Mortgage on real estate and bank funds.
BARNSTABLE. — Real estate and bonds.
BAY STATE. —
BERKSHIRE. — Real estate.
BLACKSTONE VALLEY. — Real estate.
BRISTOL. — Real estate.
DEERFIELD VALLEY. — Real estate and bank funds.
EASTERN HAMPDEN. — Real estate.
ESSEX. — Bank stocks and farm.
FRANKLIN. — Real estate and bank stock.
HAMPDEN. —
HAMPSHIRE. — Real estate.
HAMPSHIRE, FRANKLIN AND HAMPDEN. — Real estate and personal property.
HIGHLAND. — Real estate.
HILLSIDE. — Real estate and personal property.
HINGHAM. — Real estate and personal property.
HOOSAC VALLEY. — Real estate and personal property.
HOUSATONIC. — Real estate, railroad bonds, bank funds.
MARSHFIELD. — Real estate.
MARTHA'S VINEYARD. — Real estate, notes and bank funds.
MASSACHUSETTS HORTICULTURAL. — Real estate.
MIDDLESEX. —
MIDDLESEX NORTH. — Real estate.
MIDDLESEX SOUTH. — Real estate.
NANTUCKET. — Real estate.
OXFORD. — Real estate.
PLYMOUTH. — Real estate and personal property.
SPENCER. — Real estate.
UNION. — Real estate and personal property.
WORCESTER. — Real estate.
WORCESTER NORTH. — Real estate and bank funds.
WORCESTER NORTH-WEST. — Real estate and personal property.
WORCESTER SOUTH. — Real estate and personal property.
WORCESTER WEST. — Real estate and personal property.

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED.

SOCIETIES.	Total Amount offered for Management and Improvement of Farms, Orchards, etc.	Total Amount paid for Management and Improvement of Farms, Orchards, etc.	For Neat and Dairy Stock.	For Horses.	For all other Farm Stock.	Total Amount offered for Live Stock.	Total Amount paid out for Live Stock.	For Cereals and Seeds.	For Roots and Vegetables.	Total Amount offered for Grain and Root Crops.	Total Amount paid out for Grain and Root Crops.	For Fruits, Flowers, etc.	For Dairy Products.	For Bread, Honey and Preserved Fruits.	Total Amount paid out under the head of Farm Products.
Amesbury and Salisbury,	$100 00	$11 00	$72 00	$33 00	$33 50	$291 00	$138 50	$3 00	$26 00	$90 00	$5 00	$72 30	$3 00	$5 50	$124 55
Barnstable,	142 00	50 50	125 50	86 00	359 25	703 25	570 75	13 00	95 35	202 00	108 35	102 70	16 00	40 00	158 70
Bay State,	-	-	2,552 00	1,712 00	2,241 00	8,750 50	-	59 00	518 00	776 00	557 00	524 00	275 00	98 00	-
Berkshire,	92 00	71 00	457 00	224 00	289 00	1,204 00	970 00	102 00	81 00	240 00	183 00	96 50	38 00	52 00	520 00
Blackstone Valley,	110 00	98 00	199 00	20 00	113 00	516 00	341 00	7 00	20 75	58 00	27 75	54 00	6 50	8 25	96 50
Bristol,	250 00	104 00	546 00	282 00	220 00	1,700 00	1,048 00	30 00	73 25	275 00	103 25	194 25	47 00	30 50	375 00
Deerfield Valley,	-	-	197 00	135 00	123 00	600 00	455 00	9 45	7 60	20 00	17 05	53 10	12 00	15 75	97 90
Eastern Hampden,	98 00	10 00	101 00	120 00	116 00	706 50	436 00	23 00	23 00	95 50	46 00	46 25	15 00	12 75	120 00
Essex,	385 00	165 00	282 00	224 00	174 00	1,702 00	568 00	40 00	123 00	255 00	-	493 75	18 00	24 50	563 75
Franklin,	-	-	227 00	133 00	256 00	685 75	615 00	9 00	43 50	71 00	51 00	108 50	13 00	13 50	184 00
Hampden,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hampshire,	-	-	99 00	111 00	179 00	539 00	389 00	10 50	22 00	47 00	42 00	101 00	9 00	18 50	147 50
Hampshire, Franklin and Hampden,	-	-	270 00	159 00	138 00	673 00	541 00	20 00	58 75	61 00	71 25	81 50	28 00	20 00	178 00
Highland,	-	-	149 00	103 00	77 50	524 00	329 50	19 50	28 80	58 00	48 30	24 75	7 50	10 30	90 85

Hillside, . . .	21 00	21 00	170 00	109 00	66 00	428 00	416 00	36 50	13 50	40 00	39 70	36 50	23 00	17 75	126 95
Hingham, . .	224 75	3 00	201 50	9 00	94 50	908 75	305 00	-	45 10	170 75	45 10	114 40	14 50	31 75	205 75
Hoosac Valley, .	65 00	53 00	152 00	205 00	242 00	872 00	592 00	159 75	84 50	259 00	244 25	99 25	39 50	46 50	429 50
Housatonic, . .	155 00	120 00	462 00	263 00	771 50	1,589 00	1,296 50	347 00	116 00	509 00	495 00	157 00	52 00	89 00	793 00
Marshfield, . .	67 00	3 25	142 50	128 50	71 50	400 00	342 50	-	68 22	211 00	68 22	95 00	20 00	50 80	234 02
Martha's Vineyard,	34 00	10 00	87 40	36 00	144 75	346 00	268 15	35 50	52 90	156 50	52 50	40 75	16 50	21 85	143 60
Massachusetts Horticultural, . .	390 00	30 00	-	-	-	-	-	83 00	225 00	233 00	-	5,238 50	-	-	6,034 00
Middlesex, . .	93 00	-	66 00	60 00	225 25	812 00	474 00	11 25	48 00	173 50	44 50	189 50	5 00	33 00	369 50
Middlesex North, .	-	-	115 00	135 00	104 05	780 00	309 00	19 50	36 50	-	-	202 25	10 00	40 00	-
Middlesex South, .	33 00	24 00	132 00	82 00	67 00	438 50	280 00	11 50	35 75	142 50	47 25	71 70	4 00	22 75	161 20
Nantucket, . .	72 00	-	175 50	63 50	75 50	653 75	259 00	8 50	44 50	187 00	16 75	64 00	9 00	22 75	147 75
Oxford, . . .	28 00	-	222 00	82 00	69 00	645 00	349 50	5 25	5 00	16 00	7 50	8 25	6 00	6 25	28 26
Plymouth, . .	211 00	-	425 00	165 00	193 50	943 00	783 50	20 00	14 00	84 00	34 00	142 75	32 00	78 25	287 00
Spencer, . . .	32 00	-	294 00	98 00	57 25	647 50	381 25	15 50	32 00	63 00	34 00	71 50	18 00	13 25	136 75
Union, . . .	16 00	4 50	272 75	116 00	239 50	875 75	496 50	15 00	22 25	88 50	37 25	40 75	5 75	18 50	99 63
Worcester, . .	129 00	-	2,943 01	600 00	507 37	5,280 00	4,110 00	36 99	137 99	299 00	271 97	426 50	111 00	-	819 47
Worcester North, .	29 00	24 00	130 50	58 00	59 50	321 00	250 00	5 50	32 00	46 50	39 00	177 25	13 25	11 65	-
Worcester Northwest, . . .	31 00	14 00	357 00	182 00	103 00	1,047 00	623 50	27 00	21 00	72 00	45 33	51 75	13 00	12 00	114 58
Worcester South, .	95 00	25 00	484 00	876 00	236 00	1,799 00	-	18 00	25 00	126 50	81 50	91 75	32 00	32 00	289 50
Worcester West, .	60 00	29 50	258 50	182 00	79 00	698 00	475 00	8 00	20 00	51 00	27 75	37 35	17 00	12 00	92 50
	$2,962 75	$870 75	$12,457 16	$6,810 00	$7,725 42	$38,079 25	$18,413 15	$1,209 19	$2,200 21	$5,186 25	$2,891 52	$9,309 30	$929 50	$9 0960	$13,169 71

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED — *Concluded.*

SOCIETIES.	For Agricultural Implements.	Offered for raising Forest Trees.	For Experiments in Manures.	Amount awarded for Objects strictly Agricultural, not already specified.	Amount awarded and paid out for Trotting Horses.	For Objects not strictly Agricultural: Domestic Manufactures.	Number of Persons who received Premiums and Gratuities.
Amesbury and Salisbury,	$5 00	$10 00	$15 00	-	-	$131 00	170
Barnstable,	-	30 00	-	-	$250 00	114 95	453
Bay State,	-	-	-	-	-	273 00	-
Berkshire,	27 00	-	-	$150 50	960 00	866 50	423
Blackstone Valley,	-	-	-	-	-	85 50	162
Bristol,	135 00	23 00	60 00	-	1,546 73	403 00	440
Deerfield Valley,	-	-	-	18 00	50 00	94 35	300
Eastern Hampden,	-	25 00	-	-	405 00	65 13	128
Essex,	27 00	30 00	25 00	26 00	-	196 00	402
Franklin,	-	10 00	-	9 00	586 00	110 60	310
Hampden,	-	-	-	-	-	-	-
Hampshire,	-	16 00	-	-	30 00	89 77	171
Hampshire, Franklin, and Hampden,	18 00	20 00	-	-	400 00	109 75	170
Highland,	3 00	-	-	-	34 00	146 35	154
Hillside,	10 00	-	-	-	-	67 75	309
Hingham,	5 00	63 75	-	-	-	98 32	320
Hoosac Valley,	17 00	-	-	33 00	1,100 00	243 50	272
Housatonic,	-	-	-	32 00	552 50	334 50	482
Marshfield,	-	50 00	-	-	457 00	129 82	375
Martha's Vineyard,	5 00	5 00	9 00	-	-	182 80	202
Massachusetts Horticultural,	-	10 00	-	-	-	-	215
Middlesex,	-	50 00	-	-	75 00	91 00	984
Middlesex North,	-	-	-	-	-	-	303
Middlesex South,	-	45 00	-	45 00	180 00	44 70	164
Nantucket,	-	21 00	15 00	-	-	123 65	260
Oxford,	4 00	-	-	-	300 00	44 00	129
Plymouth,	5 00	60 00	-	-	860 00	184 25	364
Spencer,	13 50	15 00	-	-	270 00	34 00	186
Union,	-	-	-	15 45	370 00	127 75	226
Worcester,	-	-	-	80 00	3,657 50	586 13	401
Worcester North,	38 50	25 00	-	311 70	550 00	86 95	-
Worcester North-west,	5 00	30 00	-	-	850 00	81 46	162
Worcester South,	8 00	35 00	-	-	575 00	423 20	233
Worcester West,	5 00	30 00	10 00	-	468 00	138 80	191
	$331 00	$603 75	$134 00	$720 65	$14,526 73	$5,708 48	9,061

OFFICERS OF THE AGRICULTURAL SOCIETIES, 1889.

AMESBURY AND SALISBURY.

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Secretary — JOHN Q. EVANS of Salisbury.

BARNSTABLE.

President — JOHN SIMPKINS of Yarmouth.
Secretary — FRED C. SWIFT of Yarmouthport.

BAY STATE.

President — HENRY S. RUSSELL of Milton.
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Secretary — FREDERICK L. GREENE of Greenfield.

HAMPDEN.

President — CHARLES F. FOWLER of Westfield.
Secretary — ETHAN BROOKS of West Springfield.

HAMPSHIRE.

President — L. W. WEST of Hadley.
Secretary — FRANK E. PAIGE of Amherst.

HAMPSHIRE, FRANKLIN AND HAMPDEN.

President — EDWIN C. CLAPP of Northampton.
Secretary — L. C. FERRY of Northampton.

HIGHLAND.

President — EDWARD PEASE of Huntington.
Secretary — JONATHAN McELWAIN of Middlefield.

HILLSIDE.

President — ALVAN BARRUS of Goshen.
Secretary — WM. G. ATKINS of West Cummington.

HINGHAM.

President — EBED L. RIPLEY of Hingham Centre.
Secretary — WM. H. THOMAS of Hingham.

HOOSAC VALLEY.

President — JAMES M. WATERMAN of Williamstown.
Secretary — GEORGE F. MILLER of North Adams.

HOUSATONIC.

President — THEODORE S. BALDWIN of Egremont.
Secretary — HENRY T. ROBBINS of Great Barrington.

MARSHFIELD.

President — JOHN H. PARKS of Duxbury.
Secretary — FRANCIS COLLAMORE of Pembroke.

MARTHA'S VINEYARD.

President — WM. J. ROTCH of Tisbury.
Secretary — B. T. HILLMAN of Chilmark.

MASSACHUSETTS.

President — THOMAS MOTLEY of Jamaica Plain.
Secretary — E. F. BOWDITCH of Framingham.

MASSACHUSETTS HORTICULTURAL.

President — Dr. HENRY P. WALCOTT of Cambridge.
Secretary — ROBERT MANNING of Boston.

MIDDLESEX.

President — W. W. RAWSON of Arlington.
Secretary — WM. H. HUNT of Concord.

MIDDLESEX NORTH.

President — A. C. VARNUM of Lowell.
Secretary — E. T. ROWELL of Lowell.

MIDDLESEX SOUTH.

President — N. B. DOUGLAS of Sherborn.
Secretary — EDGAR POTTER of South Framingham.

NANTUCKET.

President — GEORGE H. GARDNER of Nantucket.
Secretary — ALBERT EASTON of Nantucket.

OXFORD.

President — J. P. DANA of Oxford.
Secretary — W. H. H. THURSTON of Oxford.

PLYMOUTH.

President — JAMES C. SWAN of West Bridgewater.
Secretary — G. W. R. HILL of Brockton.

SPENCER.

President — CHARLES N. PROUTY of Spencer.
Secretary — T. J. COMINS of Spencer.

UNION.

President — HENRY K. HERRICK of Blandford.
Secretary — ENOS W. BOISE of Blandford.

WORCESTER.

President — J. LEWIS ELLSWORTH of Worcester.
Secretary — L. F. HERRICK of Worcester.

WORCESTER NORTH.

President — GEORGE CRUICKSHANKS of Fitchburg.
Secretary — S. W. HUNTLEY of Fitchburg.

WORCESTER NORTH-WEST.

President — JOHN D. MORTON of Boston.
Secretary — J. F. WHITCOMB of Athol.

WORCESTER WEST.

President — P. M. HARWOOD of Barre.
Secretary — GEORGE W. COOK of Barre.

WORCESTER SOUTH.

President — E. B. LYNDE of West Brookfield.
Secretary — C. V. COREY of Sturbridge.

AGRICULTURAL EXHIBITIONS, 1889.

AMESBURY AND SALISBURY at *Amesbury*, October 1 and 2.
BAY STATE (date not given).
BARNSTABLE at *Barnstable*, September 24 and 25.
BERKSHIRE at *Pittsfield*, September 10, 11, 12 and 13.
BLACKSTONE VALLEY at *Uxbridge*, September 24 and 25.
BRISTOL at *Taunton*, September 24, 25 and 26.
DEERFIELD VALLEY at *Charlemont*, September 12 and 13.
EASTERN HAMPDEN at *Palmer*, September 17 and 18.
ESSEX at *Beverly*, September 24 and 25.
FRANKLIN at *Greenfield*, September 26 and 27.
HAMPDEN at *Westfield*, September 18 and 19.
HAMPSHIRE at *Amherst*, September 19 and 20.
HAMPSHIRE, FRANKLIN AND HAMPDEN at *Northampton*, October 2 and 3.
HIGHLAND at *Middlefield*, September 4 and 5.
HILLSIDE at *Cummington*, September 24 and 25.
HINGHAM at *Hingham*, September 24 and 25.
HOOSAC VALLEY at *North Adams*, September 17, 18 and 19.
HOUSATONIC at *Great Barrington*, September 25, 26 and 27.
MASSACHUSETTS HORTICULTURAL at *Boston*, September 17, 18, 19 and 20.
MARSHFIELD at *Marshfield*, September 11, 12 and 13.
MARTHA'S VINEYARD at *West Tisbury*, September 3 and 4.
MIDDLESEX at *Concord*, September 25 and 26.
MIDDLESEX NORTH at *Lowell*, September 24 and 25.
MIDDLESEX SOUTH at *Framingham*, September 17 and 18.
NANTUCKET at *Nantucket*, September 4 and 5.
OXFORD at *Oxford*, September 17 and 18.
PLYMOUTH at *Bridgewater*, September 18 and 19.
SPENCER at *Spencer*, October 3 and 4.
UNION at *Blandford*, September 11 and 12.
WORCESTER at *Worcester*, September 19 and 20.
WORCESTER NORTH at *Fitchburg*, September 24 and 25.
WORCESTER NORTH-WEST at *Athol*, September 17 and 18.
WORCESTER SOUTH at *Sturbridge*, September 12 and 13.
WORCESTER WEST at *Barre*, September 26 and 27.

APPENDIX.

STATUTES RELATING TO THE STATE BOARD OF AGRICULTURE.

PUBLIC STATUTES.—CHAPTER 20.

INDEX.

SECTION 1. The governor, lieutenant-governor, and secretary of the commonwealth, the president of the agricultural college, one person appointed from and by each agricultural society which receives an annual bounty from the commonwealth, and three other persons appointed by the governor with the advice and consent of the council, shall constitute the state board of agriculture. Board, how constituted.

SECT. 2. One-third of the appointed members of said board shall retire from office on the first Wednesday of February in each year, according to their appointments. The vacancies thus occurring shall be filled by the governor and council, or by the agricultural societies, as the offices were before filled, and the persons thus appointed shall hold their offices for three years from the expiration of the former terms. Other vacancies may be filled in the same manner for the remainder of the vacant terms. Tenure of office of members. Vacancies, how filled.

Where and how often to meet.

SECT. 3. The board shall meet at the state house or at the agricultural college at least once in each year, and as much oftener as may be deemed expedient. No member of said board shall receive compensation from the commonwealth except for personal expenses when engaged in the duties of the board.

To receive no compensation.

Secretary and clerk and their salaries.

SECT. 4. The board may appoint and prescribe the duties of a secretary, who shall receive a salary of two thousand dollars a year; and who, at such times as the board shall approve, may employ a clerk at a salary of eleven hundred dollars a year, and may expend for other clerical services in his office, and for lectures to be given before the board of agriculture at its annual and other meetings, a sum not exceeding four hundred dollars.

Salary established.

[Section 4 has been amended by Acts of 1883, chap. 184, sect. 1: The secretary of the board of agriculture shall receive an annual salary of twenty-five hundred dollars, and at the same rate for any part of a year.

Clerical services. Lectures.

Also, by Acts of 1884, chap. 66, sect. 1: The secretary of the board of agriculture may expend for other clerical services in his office, and for lectures to be given before the board at its annual and other meetings, a sum not exceeding eight hundred dollars per annum.

Salary established.

Also, by Acts of 1887, chap. 245, sect. 1: The clerk of the secretary of the state board of agriculture shall receive an annual salary of twelve hundred dollars.]

Board to be overseers of agricultural college.

SECT. 5. The board shall be a board of overseers of the Massachusetts Agricultural College, with powers and duties to be defined and fixed by the governor and council, but such powers shall not control the action of the trustees of said college, or negative their powers and duties as defined by chapter two hundred and twenty of the acts of the year eighteen hundred and sixty-three.

to investigate subjects relating to agriculture, take donations, etc.

SECT. 6. The board shall investigate such subjects relating to improvement in agriculture in this commonwealth as they may think proper, and may take, hold in trust, and exercise control over donations or bequests made to them for promoting agricultural education or the general interests of husbandry.

to fix days for annual meetings of agricultural societies, etc.

SECT. 7. They may fix the days on which the different agricultural societies shall commence their exhibitions, and may prescribe forms for and regulate

the returns required of said societies, and shall furnish to the secretary of each society such blanks as they may deem necessary to secure uniform and reliable statistics.

Board to report to general court.

SECT. 8. They shall annually, on or before the fourth Wednesday of January, by their chairman or secretary, submit to the general court a detailed report of their doings, with such recommendations and suggestions as the interests of agriculture may require.

Secretary to publish abstracts, etc.

SECT. 9. The secretary of the board shall in each year cause to be made and published for distribution as full an abstract of the returns of the agricultural societies as he may deem useful.

may appoint agents.

SECT. 10. He may appoint one or more suitable agents to visit, under the direction of the board, the towns in the commonwealth for the purpose of inquiring into the methods and wants of practical husbandry; of ascertaining the adaptation of agricultural products to soil, climate, and markets; of encouraging the establishment of farmers' clubs, agricultural libraries, and reading-rooms; and of disseminating useful information in agriculture by means of lectures or otherwise; and such agents shall annually in October make to the secretary detailed reports.

AN ACT AUTHORIZING TOWNS AND CITIES TO PROVIDE FOR THE PRESERVATION AND REPRODUCTION OF FORESTS.

[Chapter 255, Acts of 1882, Sections 1, 2, 3, 4 and 5.]

Preservation and culture of forest trees by cities and towns.

SECTION 1. The voters of any town, at a meeting legally called for the purpose, and the city council of any city, may, for the purpose of devoting a portion of the territory of such town or city to the preservation, reproduction and culture of forest trees for the sake of the wood and timber thereon, or for the preservation of the water supply of such town or city, take or purchase any land within the limits of such town or city, may make appropriations of money for such taking or purchase, may receive donations of money or land for the said purposes, and may make a public domain of the land so devoted, subject to the regulations hereinafter prescribed. The title of all lands so taken, purchased or received shall vest in the Commonwealth, and

shall be held in perpetuity for the benefit of the town or city in which such land is situated.

Description of the land taken to be recorded in the registry of deeds.

SECT. 2. A town or city taking land under this act shall, within sixty days after such taking, file and cause to be recorded in the registry of deeds for the county or district in which the land is situated a description thereof sufficiently accurate for identifying the same. In case such town or city and the owner of such land do not agree upon the damage occasioned by such taking, such damage shall be ascertained and determined in the manner provided in case of the taking of land for a highway in such town or city, and such town or city shall thereupon pay such sums as may finally be determined to be due.

Board of forestry to serve without pay; to appoint keepers.

SECT. 3. The state board of agriculture shall act as a board of forestry, without pay, except for necessary travelling expenses, and shall have the supervision and management of all such public domains, and shall make all necessary regulations for their care and use and for the increase and preservation of the timber, wood and undergrowth thereon, and for the planting and cultivating of trees therein. The said board shall appoint one or more persons, to be called keepers, to have charge, subject to its direction, of each such public domain, enforce its regulations and perform such labor thereon as said board shall require; and said keepers shall have the same power to protect such domain from injury and trespass, and to keep the peace therein as constables and police officers in towns.

may lease buildings on land.

Proceeds of sale of products to be paid to board.

SECT. 4. Said board may lease any building that may be on any such public domain on such terms as it shall deem expedient. All sums which may be derived from rents and from the sale of the products of any such domain shall be paid to said board and shall be applied by it, so far as necessary, to the management, care, cultivation and improvement of such domain; and any surplus remaining in any year shall be paid over to the city or town in which such domain is situated. Said board shall not, however, expend upon or on account of any such public domain in any year a greater amount than it receives as aforesaid.

Buildings for instruction and recreation may be built.

SECT. 5. A city or town in which any such public domain is situated may erect thereon any building for public instruction or recreation, provided that such use

thereof is not in the judgment of said board inconsistent with the purposes expressed in section one.

An Act to Establish an Agricultural Experiment Station.

[Chapter 212, Acts of 1882, Sections 1, 2 and 3.]

Section 1. An agricultural experiment station shall be established and maintained at the Massachusetts agricultural college in the town of Amherst. **Experiment station established.**

Sect. 2. The management of said station shall be vested in a board of control of seven persons of which board the governor shall be president ex officio, and of which two members shall be elected from the state board of agriculture, by said board of agriculture; two from the trustees of the Massachusetts agricultural college, by said trustees; one from the Massachusetts society for promoting agriculture, by said society; and the remaining member shall be the president of the Massachusetts agricultural college. The said board shall choose a secretary and treasurer. **Management vested in board of control.**

[Section 2 has been amended by Acts of 1888, chap. 333, sect. 1. The management of said station shall be vested in a board of control of eleven persons of which board the governor shall be president ex officio, and of which two members shall be elected from the state board of agriculture, by said board of agriculture; two from the trustees of the Massachusetts agricultural college, by said trustees; one from the Massachusetts society for promoting agriculture, by said society; one from the Massachusetts state grange, by said state grange; one from the Massachusetts horticultural society, by said society; and the remaining members shall be the president of the Massachusetts agricultural college, the director of the Massachusetts agricultural experiment station and the secretary of the state board of agriculture: *provided, however*, that no person so elected by any of the above named boards or societies shall continue to be a member of said board of control after he has ceased to be a member of the board or of the society by which he was elected. The said board shall choose a secretary and treasurer.] **Proviso.**

Board to make report to the legislature.

SECT. 3. The said board of control shall hold an annual meeting in the month of January, at which time it shall make to the legislature a detailed report of all moneys expended by its order, and of the results of the experiments and investigations conducted at said station, with the name of each experimenter attached to the report of his own work, which detailed report shall be printed in the annual report of the secretary of the state board of agriculture.

AN ACT RELATING TO THE ANNUAL REPORT OF THE BOARD OF CONTROL OF THE AGRICULTURAL EXPERIMENT STATION.

[Chapter 105, Acts of 1883.]

Agricultural experiment station to make annual report to board of agriculture.

The board of control of the agricultural experiment station shall annually, in the month of January, make a detailed report to the state board of agriculture of all moneys expended by its order, and of the results of the experiments and investigations conducted at said station, with the name of each experimenter attached to the report of his own work.

THE BOARD OF SUPERVISORS OF STATISTICS.

[P. S., Chapter 31, Section 17.]

Board of supervisors of statistics.

SECT. 17. The secretary of the commonwealth, the secretaries of the boards of agriculture, of education, and of the state board of health, lunacy, and charity, and the chief of the bureau of statistics of labor, shall constitute a board of supervisors of statistics, who shall serve without pay.

AN ACT CONCERNING THE PRINTING AND DISTRIBUTION OF CERTAIN REPORTS AND DOCUMENTS.

[Chapter 369, Acts of 1885, Section 1.]

Documents and reports.

SECT. 1. There shall be printed annually the number of copies of documents and reports specified in this section, the same to be numbered in the series of Public Documents, and distributed as herein provided:

Agriculture.

Report of secretary of board of agriculture, twelve thousand copies; twenty-five copies thereof to be furnished to each member of the legislature.

This has been amended by Acts of 1888, chap. 256 :—

SECT. 1. There shall be printed annually fifteen thousand copies of the report of the secretary of the state board of agriculture; and twenty-five thousand copies of the report of the board of control of the state agricultural experiment station. Additional reports of the secretary of the state board of agriculture, etc.

SECT. 2. Of the reports of the board of control of the state agricultural experiment station provided for in section one of this chapter, fifteen thousand copies shall be bound with reports of the secretary of the state board of agriculture, and eight thousand copies shall be for the use of the said board of control. Distribution and binding of reports.

PRINTING AND DISTRIBUTION OF PUBLIC DOCUMENTS.

[P. S., Chapter 4, Section 11.]

SECT. 11. The treasurer, auditor, attorney-general, adjutant-general, board of education, and board of agriculture, may require any portion of their reports to be put in type previous to the first Wednesday in January annually, when the same can be done consistently with the public advantage. Report of the board of agriculture may be put in type in advance.

AN ACT FOR THE SUPPRESSION OF CONTAGIOUS DISEASES AMONG DOMESTIC ANIMALS.

[Chapter 252, Acts of 1887, Section 19].

SECT. 19. Cattle commissioners now or hereafter appointed shall keep a full record of their doings, and report the same to the legislature on or before the tenth day of January in each year unless sooner required by the governor; and an abstract of the same shall be printed in the annual report of the state board of agriculture. Abstract of report of cattle commissioners to be printed in report of board of agriculture.

STATUTES RELATING TO AGRICULTURAL AND HORTICULTURAL SOCIETIES.

PUBLIC STATUTES.—CHAPTER 114.

INDEX.

Agricultural societies may be entitled to annual sum from the treasury, by, etc.

SECTION 1. Every incorporated agricultural society which was entitled to bounty from the commonwealth before the twenty-fifth day of May in the year eighteen and sixty-six, and every other such society whose exhibition grounds and buildings are not within twelve miles of those of a society then entitled to bounty, and which has raised by contribution of individuals and put out at interest on public or private security, or invested in real estate, buildings, and appurtenances for its use and accommodation, one thousand dollars, as a capital appropriated for its uses, shall, except when otherwise

determined by the state board of agriculture as provided in section three, be entitled to receive in the month of October annually, out of the treasury of the commonwealth, two hundred dollars, and in that proportion for any greater sum so contributed and put at interest or invested; but no society shall receive a larger amount in one year than it has awarded and paid in premiums during the year last preceding, nor more than six hundred dollars.

SECT. 2. Every society which claims bounty shall annually, on or before the tenth day of December, file in the office of the secretary of the board of agriculture a certificate signed by its president and treasurer, specifying under oath the sum so contributed and put at interest or invested, and then held so invested or well secured as a capital stock.

Societies claiming bounty to file certificate.

SECT. 3. The amount of bounty to which a society is entitled for any year shall be ascertained by the certificate last filed by it under the preceding section. But a society shall not receive bounty in any year, if the state board of agriculture, having first given such society full opportunity to be heard in relation to its financial affairs and general management, so determines by a two-thirds vote of the whole number of its members present at its annual meeting, and by its secretary notifies the treasurer of the commonwealth thereof on or before the first day of September in such year.

Amount of bounty. State board may withhold same.

SECT. 4. Every society receiving bounty shall make such rules and regulations for the distribution thereof as shall, in its opinion, best promote the improvement of agriculture; subject, however, to the restrictions of sections six to ten inclusive.

Societies may make rules, etc., for distribution of bounty.

SECT. 5. Every such society shall annually, on or before the tenth day of January, make a full return of its doings, signed by its president and secretary, to the secretary of the board of agriculture, embracing a statement of the expenditure of all money, specifying the nature of the encouragement proposed by the society, the objects for which its premiums have been offered, and the persons to whom they have been awarded, and including all reports of committees and all statements of experiments and cultivation regarded by the president and secretary as worthy of publication, and with such general observations concerning the

to make annual returns, with passages, etc., marked.

state of agriculture and manufactures in the commonwealth as it may deem useful.

The return shall be marked in such manner that the passages deemed by such officers most worthy of public notice, study, and application may be easily distinguished.

Forfeiture of bounty.

SECT. 6. A society which neglects in any year to comply with the laws relating thereto, or with the regulations of the board of agriculture, shall not be entitled to bounty in the year next succeeding.

Premiums to be offered by societies, etc.

SECT. 7. Every society which receives said bounty shall offer annually by way of premiums, or shall otherwise apply for the encouragement or improvement of agriculture or manufactures, a sum not less than the amount so annually received, and shall offer such premiums for agricultural experiments and in such manner as the state board of agriculture requires.

for trees for ship timber.

SECT. 8. Every society shall annually offer such premiums and encouragement for the raising and preserving of oaks and other forest trees as to it seems proper and best adapted to perpetuate within the commonwealth an adequate supply of ship timber.

All citizens of county may be members, etc.

SECT. 9. Every such society shall admit as members, upon equal terms, citizens of every town in the county in which it is located, and all premiums offered shall be subject to the competition of every citizen of such county.

Surplus to be at interest.

SECT. 10. All money offered for premiums which is not awarded or paid shall be put out at interest and added to the capital stock of the society.

To what societies provisions apply.

SECT. 11. The foregoing provisions, except the proviso in section three authorizing the state board of agriculture to withhold bounty, shall not, except by special enactment, extend to an agricultural society incorporated for any territory less than a county.

Cattle shows regulated.

SECT. 12. Every society may by its officers define and fix bounds of sufficient extent for the erection of its cattle pens and yards, and for convenient passage ways to and about the same, on the days of its cattle shows and exhibitions, and also for its ploughing matches and trials of working oxen; within which bounds no persons shall be permitted to enter or pass unless in conformity with the regulations of the officers of the society.

SECT. 13. Whoever contrary to such regulations, and after notice thereof, enters or passes within the bounds so fixed, shall forfeit a sum not exceeding five dollars. Penalty.

SECT. 14. The foregoing provisions shall not authorize a society to occupy or include within such bounds the land of any person without his consent, nor to obstruct travel on any public highway. Limit of bounds.

SECT. 15. The officers of each society may appoint a sufficient number of suitable inhabitants of the county to act as marshals at cattle shows and exhibitions, who shall have the powers of constables in relation to the preservation of the public peace and the service and execution of criminal process within the respective towns where such shows and exhibitions are held, and such process may be directed to them accordingly; and they shall exercise their office from twelve o'clock at noon of the day preceding the commencement of such shows and exhibitions until twelve o'clock at noon of the day succeeding the termination thereof, and no longer. Marshals to be appointed; to have powers of constables.

SECT. 16. The state board of agriculture may prescribe rules and regulations to societies for uniform modes of ascertaining the product of crops entered for premium. Rules for ascertaining the amount of premium crops.

SECT. 17. Any agricultural society may offer and pay premiums for experiments in the cultivation of crops or in the raising of domestic animals for farm purposes, and no regulation of the board of agriculture to the contrary shall be valid. Premiums for experiments.

ASSOCIATIONS FOR ENCOURAGING AGRICULTURE, ETC.

SECT. 18. Ten or more persons in any county, city, or town, who by agreement in writing associate for the purpose of encouraging agriculture or horticulture, or for improving and ornamenting the streets and public squares of any city or town by planting and cultivating ornamental trees therein, may become a corporation by such name as they assume therefor upon calling their first meeting and organizing in the manner provided in sections twelve and thirteen of chapter forty; and shall thereupon during the pleasure of the general court have for their purposes all the rights, powers, and privileges Ten or more persons may become a corporation. Powers and privileges.

given by sections twelve to fifteen, inclusive, of said chapter, and may hold real and personal estate not exceeding ten thousand dollars in value.

Farmers' Clubs.

Farmers' clubs to receive publications, etc.

Sect. 19. Farmers' clubs properly organized and holding regular meetings shall, upon application made annually in November to the secretary of the state board of agriculture, receive copies of its report and of its other publications, in proportion to the number of their members and to the applications so made. Every club receiving such copies shall annually in October make returns to said secretary of its agricultural experiments and of the reports of its committees.

Good Order at Fairs, etc.

Societies, etc., may make regulations for preservation of peace at fairs, etc.

Sect. 20. Any agricultural society or farmers' club may establish such regulations, not repugnant to law, as it may deem necessary and expedient for the preservation of peace and good order or for the protection of its interests at its regular or annual meetings, shows, fairs, or exhibitions, and shall cause at least five copies of such regulations to be posted in as many public places on its grounds not less than forty-eight hours before the time of holding each meeting.

Booths, etc., for sale of goods, not to be established within half mile of cattle shows, etc., without consent.

Sect. 21. No person during the time of holding a cattle show, fair, or exhibition, or meeting of a farmers' club, without the consent of the proper authorities having charge of the same, shall establish within one half mile of the place of holding such show or meeting a tent, booth, or vehicle of any kind for the purpose of vending any goods, wares, merchandise, provisions, or refreshments. No person shall engage in any gaming or horse-racing or exhibit any show or play during the regular or stated time of holding any cattle show, agricultural fair, or meeting of any farmers' club, or engage in pool-selling, at or within half a mile of the place of holding the same: *provided*, that any person having his regular place of business within such limits shall not be hereby required to suspend his business.

Gaming, horse-racing, etc., prohibited.

Penalty.

Sect. 22. Whoever violates any provision of the preceding section, or a regulation established under section twenty, shall forfeit for such offence a sum not exceeding twenty dollars.

Of the Suppression of Common Nuisances.

[P. S., Chapter 101.]

Booths, etc., used for gaming, etc., near cattle shows, etc., how removed.

Sect. 10. The mayor and aldermen or selectmen of any place, upon complaint made to them under oath that the complainant has reason to believe and does believe that a booth, shed, or other temporary erection, situated within one mile of a muster-field, cattle-show ground, or other place of public gathering, is used and occupied for the sale of spirituous or fermented liquor, or for the purpose of gaming, may, if they consider the complaint well founded, order the owner or occupant thereof to vacate and close the same forthwith. If the owner or occupant refuses or neglects so to do, the mayor and aldermen or selectmen may forthwith abate such booth, shed, or erection as a nuisance, and pull down or otherwise destroy the same in any manner they choose, or through the agency of any force, civil or military.

Of Gaming.

[P. S., Chapter 99.]

Gaming at cattle shows, musters, etc.

Sect. 11. Whoever during or within twelve hours of the time of holding a cattle-show, military muster, or public gathering, within one mile of the place thereof, practises or engages in any gambling or unlawful game, shall forfeit for each offence a sum not exceeding twenty dollars. If he is discovered in the act, he may be arrested by any sheriff, deputy-sheriff, constable, or other civil officer, and lawfully detained, by imprisonment in jail or otherwise, not exceeding twenty-four hours, until a complaint is made against him for the offence.

Of Offences Against Public Policy.

[P. S., Chapter 209.]

Racing, etc., declared unlawful, except trials of speed at cattle shows.

Sect. 11. All racing, running, trotting, or pacing of a horse or other animal of the horse kind for a bet or wager of money or other valuable thing, or for a purse or stake, made within this state, except trials of the speed of horses for premiums offered by legally constituted agricultural societies, is declared to be unlawful;

and any person engaged in such racing, running, trotting, or pacing, for any such bet or wager, purse or stake, or aiding or abetting the same, shall be punished by fine not exceeding one thousand dollars, or imprisonment in the jail not exceeding one year, or by both such fine and imprisonment.

Penalty.

Property and Persons Exempted from Taxation.

[P. S., Chapter 11.]

Estate of agricultural societies.

Sect. 5. The following property and polls shall be exempted from taxation: . . . . .
Ninth, The estate, both real and personal, of incorporated agricultural societies.

REGULATIONS OF THE BOARD OF AGRICULTURE.

1. The Board shall hold an annual business meeting at the office of the secretary in Boston, commencing on the Tuesday preceding the first Wednesday in February, and continuing through the following Wednesday, on which day the new members may take their seats. The meeting will be prolonged as business may require. The business of the Board shall be conducted in accordance with the rules used by deliberative bodies. Annual meeting.

No member shall speak more than once until others who have not spoken shall speak if they desire it, nor more than twice without first having obtained leave of the Board.

No member in debate shall occupy more than ten minutes at a time without leave of the Board.

2. At the annual meeting an executive committee consisting of five members shall be chosen, whose duty shall be to act for the Board in cases of emergency. Executive committee.

3. The times for holding the fairs of the agricultural societies receiving bounty from the State of Massachusetts shall be as follows: — Times for holding the fairs of the several societies.

Amesbury and Salisbury, 5th Tuesday after the 1st Monday in September.

Barnstable, 4th Tuesday after the 1st Monday in September.

Bay State.

Berkshire, 2d Tuesday after the 1st Monday in September.

Blackstone Valley, 4th Tuesday after the 1st Monday in September

Bristol, 4th Tuesday after the 1st Monday in September.

Deerfield Valley, 2d Thursday after the 1st Monday in September

Eastern Hampden, 3d Tuesday after the 1st Monday in September.

Essex, 4th Tuesday after the 1st Monday in September.

Franklin, 4th Thursday after the 1st Monday in September.
Hampden, 3d Wednesday after the 1st Monday in September.
Hampshire, 3d Thursday after the 1st Monday in September.
Hampshire, Franklin and Hampden, 5th Wednesday after the 1st Monday in September.
Highland, 1st Wednesday after the 1st Monday in September.
Hillside, 4th Tuesday after the 1st Monday in September.
Hingham, 4th Tuesday after the 1st Monday in September.
Hoosac Valley, 3d Tuesday after the 1st Monday in September.
Housatonic, 4th Wednesday after the 1st Monday in September.
Massachusetts.
Massachusetts Horticultural, 3d Tuesday after the 1st Monday in September.
Marshfield, 2d Wednesday after the 1st Monday in September.
Martha's Vineyard, 1st Tuesday after the 1st Monday in September.
Middlesex, 4th Wednesday after the 1st Monday in September.
Middlesex North, 4th Tuesday after the 1st Monday in September.
Middlesex South, 3d Tuesday after the 1st Monday in September.
Nantucket, 1st Wednesday after the 1st Monday in September.
Oxford, 3d Tuesday after the 1st Monday in September.
Plymouth, 3d Wednesday after the 1st Monday in September.
Spencer, 5th Thursday after the 1st Monday in September.
Union, 2d Wednesday after the 1st Monday in September.
Worcester, 3d Thursday after the 1st Monday in September.
Worcester North, 4th Tuesday after the 1st Monday in September.
Worcester North-west, 3d Tuesday after the 1st Monday in September.
Worcester South, 2d Thursday after the 1st Monday in September.
Worcester West, 4th Thursday after the 1st Monday in September.

Society joining with the New England society's exhibition.

4. Any society joining with the New England Society's exhibition will be allowed to change its time to conform to that, and such society will be allowed to merge its show with it without forfeiture of bounty.

Delegates appointed by the board, and to make reports.

5. At the annual meeting a delegate shall be appointed to attend the fair of each society represented on the Board and to make report in writing to the Board at the next annual meeting of the fair, and of the condition and work of such society.

In case a delegate cannot attend a fair.

6. If such delegate be unable to fill the appointment, he may exchange with any other delegate, but in case he cannot make such exchange he shall seasonably notify the secretary, who shall appoint a substitute.

If no visiting delegate appears at a fair of a society, it shall be the duty of the member from that society to make a report to the Board.

7. It shall be the duty of the secretary of this Board to transmit to the secretary of each society the report of the visiting delegate.

The secretary to transmit reports of delegates.

8. The following is established as the standard by which crops shall be estimated by weight by the several societies: Indian corn in the cob as taken from the field shall be rated as 80 pounds to a bushel; a bushel of Indian corn, shelled or dry, shall be 56 pounds; a bushel of rye 56 pounds; a bushel of barley 48 pounds; a bushel of buckwheat 48 lbs; a bushel of oats 32 pounds; a bushel of wheat 60 pounds; a bushel of potatoes 60 pounds; a bushel of carrots 55 pounds; a bushel of onions 52 pounds; a bushel of sugar beets 60 pounds; a bushel of mangel wurzel 60 pounds; a bushel of ruta baga 60 pounds; a bushel of parsnips 45 pounds; a bushel of common or English turnips 50 pounds; a bushel of white beans 60 pounds; a bushel of peas 60 pounds.

Standard by which crops shall be estimated by weight.

9. The various societies are recommended to conform to the catalogue of the American Pomological Society in the nomenclature of fruits at their exhibitions and in their publications.

Nomenclature of fruits.

10. The Board recommend that cattle entered for exhibition be kept on the grounds through the entire exhibition, and it is required that in any event they be kept on exhibition until three o'clock in the afternoon of the first day.

Cattle to be kept on the grounds.

11. No society receiving the bounty of the State shall bestow any premiums or gratuities on grade or native bulls.

Premiums on grade or native bulls.

12. Dr. Charles A. Goessmann has been elected the chemist to the State Board of Agriculture, and Dr. Charles H. Fernald as entomologist to the same Board; and as such they are introduced to the farmers of the Commonwealth.

Dr. C. A. Goessmann and Dr. C. H. Fernald, chemist and entomologist respectively.

12. There shall be a standing committee of six members, called the examining committee of the agricultural college, of whom the first two on the list shall retire at the end of each year, their places to be filled by election at the annual meeting. It shall be the duty of this committee to act for the Board of Agriculture and to

Examining committee of the agricultural college.

perform the duties prescribed for the Board by the Governor and Council, as follows: —

Duties of examining committee of the agricultural college.

1. To visit the college as often as they may deem essential for the proper performance of their duties, but at least once in each year.

2. To inspect the property of the college, including the land and buildings, especially with reference to the adaptability and sufficiency thereof for accomplishing the objects of the institution.

3. To observe the methods, extent and character of the instruction which it gives.

4. To attend the commencement exercises and examinations, and, so far as they may deem it expedient, participate therein.

5. To make report of their doings and observations, with their views, suggestions and recommendations concerning the institution and its work annually to the Legislature.

6. Power is given to perform the foregoing duties by and through a sub-committee, of not less than five members of the Board, to be selected annually, and at such times as the Board may elect.

7. To have and perform such other powers and duties as may be from time to time defined by the Governor and Council.

Secretary, how elected.

13. The secretary shall be elected at the annual meeting. The term of service shall be one year, beginning with the first of July following the election.

Special meetings of the board.

14. Special meetings of the Board may be called by the executive committee, of which one week's written notice shall be given to each member by the secretary.

Public meeting.

16. There shall be an annual three days' public meeting of the Board for lectures and discussions, at such place within the Commonwealth as the Board may designate, beginning on the first Tuesday in December.

Societies to hold three farmers' institutes.

17. Each agricultural society receiving the bounty of the Commonwealth is hereby required to arrange and hold not less than three farmers' institutes each calendar year within their limits, and the Board will render all the assistance in its power to make such institutes interesting and profitable. The secretary is expected to attend as many of these institutes as is compatible with other duties of his office, and he will provide lecturers for the institutes as far as the appro-

priation for this object will warrant. And the several agricultural societies are earnestly requested at their annual meetings to fix the dates at which they will hold the several institutes required, and the subjects they desire to have discussed, and at once notify the secretary of the Board if they desire assistance in the procuring of lecturers.

Dates for institutes to be determined.

CATTLE COMMISSIONERS' REPORT.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.

The undersigned Cattle Commissioners respectfully submit their annual report.

Horses.

The year has been one of general health for our equine stock, though during the months of October, November and December an epizootic prevailed to a limited extent, causing more or less trouble to livery owners and horse-car companies. As usual, the only contagion endangering this class of animals has been glanders, and the cases, whether actual or suspicious, have not been more numerous than in 1887. We have taken charge of, and caused the isolation of, many suspects which were afterwards released, and have condemned to slaughter seventy-six animals having the lesions of the disease. We have the best of reasons for believing that the provisions of law requiring "persons who have knowledge of, or have reason to suspect, the existence of a contagious disease among any species of domestic animals in this State, whether such knowledge is obtained by personal examination or otherwise, to forthwith give notice thereof to the board of health of the city or town where such diseased animals are kept," is too often disregarded, and in such a manner that detection and conviction is nearly impossible. The motive for this course of action, in many cases, is doubtless to escape the action of the law, which condemns such diseased animals to slaughter; but in others it is for the purpose of avoiding publicity and supposed injury to the repu-

tation of the stock and stables of the owner, though they destroy the animals. This is especially the fact in Boston, where not a case of glanders has been reported to the Board of Health during the last seven months, in which time it is certain that some animals infected with this disease have been destroyed, and many others may have been removed. There are several localities in the State which appear to be centres of infection; notably, the vicinity of Springfield and of Adams, and in these the local authorities should exercise great care and watchfulness. In our last report information was given of a peculiar case of trouble with a large number of horses belonging to the Cambridge horse-car company, of which, at one time, we had isolated 192 animals as suspects. They presented some abnormal conditions of the lymphatics and of the mucous surfaces, but none of the lesions which all agree are evidence of glanders. The members of the Board entertained radical differences of opinion in relation to the import of the conditions found, and their proper course of action in the disposal of the case; but as, with a single exception, there was no evidence of the disease in the acute form among the many hundreds of animals we examined, the 192 we isolated, or the many thousands with which they were brought in daily contact, and should have developed the disease if it really existed, the opinion was formed by a majority of the Board that the isolated suspects were not a public danger, and they were from time to time set at liberty and put back upon the road to their work, the last eight being released April 2, seven months after their first isolation. Under direction of the Board, 178 of these suspected horses were quartered at the Murray Street stable and worked together. We visited this stable and examined a number of the horses December 28, fourteen months after they were first placed under surveillance, and found them in the same condition as when first isolated, *apparently in perfect health*, in the opinion of the majority of the Board, as well as all the other horses which were stabled with them. The suspects had performed fully their proportionate share of the work of the company; there had been no known cases of glanders, and but two deaths from any cause. At this date no facts have developed which prove that the public safety

was endangered or a mistake made by setting these horses at liberty; but their future will be watched with much interest.

Neat Stock.

We have been frequently notified by boards of health and private individuals of cases of supposed contagious disease among cattle, particularly of contagious pleuro-pneumonia. But examination proved that the trouble was ordinary pneumonia, or that complicated with some form of anthrax. There has been no contagion among this stock, unless it has been in the form of pulmonary tuberculosis. From year to year this disease is attracting more and more attention. Investigations and experiments are being made in relation to its pathology, its character as a contagion, the laws which control or modify its dissemination and periods of development. The disease is not new, but was known and described centuries before the Christian era. It has prevailed in all the temperate and semi-tropical regions of the world in the human species, and all domestic animals except, perhaps, the horse. Its lesions are nearly identical in all, and under certain circumstances it may possibly be communicated from species to species. Whatever diversity of opinion may exist as to its virility as a contagion, all agree that it is hereditary. Sanitary statistics in Massachusetts show that sixteen per cent. of deaths among humans are caused by it, but this cannot be taken as the ratio of its prevalence among bovines. There is an accumulation of facts which makes it quite certain that the milk and meat of tuberculous cattle is not healthy food unless it is heated to 150 degrees. The commissioners have not believed that the provisions of our law are sufficient to enable them by its force to curtail or eradicate this disease, but they do believe that much would be accomplished in this direction if stock owners would cease to breed from suspected cows, and as fast as possible send them and their present progeny to slaughter. During the year Dr. Winchester, the veterinarian of the Board, in connection with several other members of the profession, has made a somewhat extended examination of herds of cattle in different parts of the State in relation to the prevalence of this disease, the account of which will be appended to this report.

Hog Cholera.

This disease is more or less prevalent in the State. No new facts have been found which lead us to change the opinion heretofore expressed in relation to the manner in which it is brought here. Our observations for several years have proved that with us it rarely if ever spreads from herd to herd, but is fed to them in the refuse of pork brought from the West and which contains its germ. This fact has been so often stated, and is so well known, that it seemed to us that all swine owners who feed it should do so at their own risk and expense, and guard the public from danger by keeping their herds strictly confined on their own premises. Accordingly, on the 24th of February regulations were issued to the boards of health of the cities and towns, directing them in all cases of disease to require strict isolation of the entire herd infected, at the expense of the owner, but in no case to appraise or slaughter the animals; also, to notify the commissioners if the contagion assumed a malignant or any peculiar type, that such measures might be adopted as the public safety required. Under this system there has been no increase of the malady, and whatever burden it may have caused, it has been borne, not by the State treasury, but by those who could see profit in swine feeding notwithstanding its risks. None of the other contagious diseases which have caused us so much trouble and loss in some former years have visited us, and though our competition with Western stock products has been sharp, ours have been reasonably prosperous.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
J. F. WINCHESTER, V. S.,
Cattle Commissioners.

Boston, Jan. 7, 1889.

APPENDIX.

TUBERCULOSIS.

Tuberculosis undoubtedly prevails among the domesticated animals over the entire globe, and has been well defined as a universal panzootic.

Its frequency depends upon various external influences, as well as constitutional predispositions of different species and breeds. The centres of this malady are met with in the great centres of human population, and in these centres a large per cent. of tuberculosis is found in mankind.

This disease is of the greatest importance, since it has been induced experimentally in animals of different species, as carnivores, herbivores, and omnivores, by inoculation and feeding for certain periods tuberculous material from the lungs and glands of diseased subjects, as well as their milk.

Since man derives a great deal, and in some instances his entire sustenance, from the flesh and milk of animals around him, we can scarcely doubt that an intimate casual correlation exists between him and them with regard to the disease.

Tuberculosis has been demonstrated to be due to the bacilli of tuberculosis by Koch, and that the germ will reproduce itself innumerable times and retain its virulence. It will not multiply outside of the animal body except by artificial means, but it has been known to retain its activity in decaying sputum for forty-three days, and in air-dried sputum for 186 days. Death has taken place from the inoculation of the bacilli into susceptible animals as soon as ten days when introduced directly into the circulation, in five or six weeks when subcutaneously inoculated, and in from three to four months when associated with infectious animals. These

facts have been well demonstrated by Koch in his numerous experiments. Animals that are not susceptible to this disease will succumb to the direct inoculation of large numbers of the bacilli. The period of incubation is an uncertain one, as will be seen from the results of the experiments made by Koch, varying as regards the amount of virus entering the system, and the susceptibility of the animal.

By artificial means this bacilli has been cultivated for eighteen months, through twenty-six successive breedings, and then found, by inoculation, to produce the morbid phenomena of tuberculosis, the same as when taken from an infected animal. This organism may gain its entrance into the system by circulation, from the mother, respiratory or digestive tracts, or through wounds on any part of the body. It has been well said that contagious diseases in general, and tuberculosis in particular, are very infrequent in habitations to which strange cattle are not admitted, and where vacancies are filled up by the home stock.

The development of the disease depends upon the surroundings, condition of the animal, the organ or tissue involved, and the amount of virus taken into the system. The first evidence of infection is an elevation of temperature, which often passes away in a few days unnoticed.

The general condition of the animal will depend on the progress that the disease has made so as to interfere with the functions of the body. This will vary from the appearance of perfect health to emaciation, with a rough, stary coat, and hide-bound. Among other symptoms, there is an enlargement of the external lymphatic glands of throat, neck and flank, and usually associated with disease in some of the internal organs. Again, there is lameness without any evidence of external cause, swelling of the joints, contraction of muscles of the neck, and abscesses along the bones.

Cases often present themselves with a cough, more or less discharge from nostrils, hurried and labored respiration, or even difficult and audible respiration with a grunt. When the digestive organs are the seat of the disease, capricious appetite, bloating, tenderness on pressure, fæces soft or constipated, and in last stages thin and fœtid. The first

evidence where the digestive organs are involved, the animal does not hold its own in flesh and general condition.

The udder is not infrequently a seat of the trouble, which shows itself in the form of small nodules or circumscribed mammiets, which do not yield readily to the treatment for garget, for which they are often mistaken. The nervous system is not exempt from its ravages, as seen in cases of paralysis or excitement, when the spinal cord or brain is affected.

The generative organs are not infrequently involved, as seen in nymphomania or continual bulling.

That the lesions of tuberculosis are not confined to any special tissue or organ, can be seen by the various symptoms it presents, as well as the different ways the virus may enter the system.

Of 200 cases that were inspected by Goring of Bavaria, in 88 cases the lesions were confined to lung and serous membranes; in 67 cases the lesions were confined to lungs only; in 33 cases the lesions were confined to serous membranes only, and in 12 cases where the disease was in other organs.

Again, in 1,596 cases of tuberculosis, carefully investigated in the Grand Duchy of Baden, 21 per cent. with lung lesions only; 28 per cent. with peritoneal and pleural lesions only; 39 per cent. with lung and pleura; 9 per cent. with general tuberculosis; 3 per cent. with genital organs.

It is a well-established fact that heredity has an influence in its propagation, and it may be transmitted by the male as well as by the female. Notwithstanding the above fact, animals may be born from tuberculous parents without any predisposition to the disease, and multiply the same as if from perfectly healthy ancestors; still, the predisposition may be inherited from tuberculous parents.

That it is an infectious disease has been well established. As long ago as 1780, Dr. Wichmann, court physician at Hanover, stated that phthisis was transmitted when exposure to infection had been frequent or long continued. The experiments of Villemin in 1864 caused him to come to the conclusion that tuberculosis was an infectious and specific malady, capable of being transmitted from one animal to another. From clinical observations tubercular phthisis is a contagious

malady equal in infectiousness to glanders and contagious pleuro-pneumonia, and contagion plays a more active part in its propagation than heredity.

It has been accepted, that: 1. Tuberculosis has been observed in all warm-blooded animals submitted to domesticity or deprived of their liberty. 2. Tuberculosis presents analogous manifestations in man and animals in life and death, and the course and terminations are the same. 3. There are clinical observations which prove the transmission of tuberculosis from animals to man by the consumption of the milk of tuberculous animals. That it is not necessary to have the udder tuberculous in order to have the milk contain the bacilli of tuberculosis, has been demonstrated by Dr. Austin Peters of Boston, he having found the bacilli in milk from a tuberculous cow where the udder was in an apparently normal condition. Fleming cites a case where two young girls were fed upon milk from tuberculous cows, and died from tuberculosis; while their brothers, more fond of whiskey than milk, were hale and hearty. In order to control this malady the diseased animals should be killed; everything that has been in contact with them thoroughly disinfected. Isolate all animals that are at all suspicious until positive symptoms manifest themselves. Never breed from an animal whose history is tainted, or about whom there is the least suspicion. As regards treatment, this disease has taxed the energies and defied the efforts of physicians for generations; and of what practical benefit could it be, since these animals are useless for breeding, dangerous for dairy purposes and as companions, and unfit for food. Our energies, therefore, should be directed towards prevention and eradication.

Having stated a few facts as to what the disease is, its cause, some of the prominent symptoms and the means necessary to combat it, it may be of interest to some to know to what extent tuberculosis was the cause of death in the human family in this State during the year 1886.

According to the Registration Report for that year, there were 39,040 deaths in this State, and of that number 7,329 died from tuberculosis, or 18.37 per cent.

From the twelve prominent causes of death, numbering 23,872, tuberculosis claims 30.7 per cent.

There were 11,772 deaths under five years of age that year, and of that number 1,372 were from tuberculosis, or 11.68 per cent. Excluding all deaths under five years old, then tuberculosis claims 21.88 per cent.

That this disease exists among the dairy stock of this State, a few facts gleaned from Drs. Penniman of Worcester, Osgood of Springfield, Bunker of Newton, Peters and Saunders of Boston, besides a few of the individuals who have suffered a loss of cattle, establishes the fact.

An examination of forty-nine herds, in different parts of this State, or 1,110 animals, shows that on thirty-four farms, where 866 bovines were kept, 239 were killed, and the examination after death sustained the diagnosis of tuberculosis. Beside these 239 that were killed, 189 presented symptoms that would cause them to be looked upon as suspicious. On the fifteen other farms, where 244 bovines were kept, twenty-eight presented symptoms that indicated tuberculosis, but none were killed to sustain the diagnosis; and beside these there were nineteen suspicious cases.

Having obtained the consent of a few gentlemen that have suffered a loss of cattle from this cause, I present the history of those outbreaks, and the rest I specify by numbers.

In the spring of 1887, at the request of Mr. Jacob C. Rogers, Dr. Austin Peters and myself made an examination of the milch cows at his farm in Peabody. There were a number of animals that presented the symptoms of tuberculosis. An inquiry into the history of the cattle kept on this farm revealed the facts: that some years previous to this the herd of Jerseys and Grades owned there had had the disease, but to what extent not known; these were disposed of about the year 1878, with the exception of one cow, which afterwards died of milk fever. For two or three years the number of cattle on the farm was limited. When the farm was stocked again it was with Guernseys, and no evidence of disease was manifested in this stock until the year 1883, when a cow, recently purchased, dropped a bull calf and then gradually failed until she died, and an examination showed the lesions of general tuberculosis. In 1885 this bull was killed, and an examination presented the same lesions as found in his dam. From that time the malady steadily gained

ground, until, in the spring of 1887, all the cattle on the farm, with a few exceptions, had been killed or otherwise disposed of, and the barn was then fumigated. Not suspecting that this trouble was infectious, new animals were added to the herd after killing the bull, in 1885, and in one instance a bull was bought in November, 1886, and in June, 1887, he was killed, and the post-mortem showed the lesions of the disease. This bull came from a farm where tuberculosis had never been known to exist. Thinking that the disinfection of the barn had been such as to remove all traces of the disease, Mr. Rogers, in May, 1888, purchased in Vermont six cows that were healthy and from a farm where tuberculosis was not known to exist, and put them in the barn from which he had taken the diseased animals. In December, 1888, only two of these animals remained in an apparently normal condition; the others, having developed the symptoms of tuberculosis, had been taken away. The forty-four animals on the farm, including the six from Vermont, have been killed or otherwise disposed of.

In December, 1884, five Guernsey cows were brought to the farm of Mr. F. L. Ames in North Easton, and in August, 1885, a bull of the same breed. During the winter of 1887 this bull began to fail, and in April of that year he was examined by Dr. J. S. Saunders of Boston, and the diagnosis of tuberculosis made, when he was killed, and the autopsy showed the lesion of tuberculosis with phthisis.

In May of the same year, after an examination of the herd (thirty-six animals) by Dr. A. Peters of Boston and myself, ten mature animals and four calves were killed. Six of the cows were Ayrshires, and the others Guernseys. The calves were killed as they were sired by the bull killed in April, and the others as they presented symptoms of tuberculosis, which were sustained by the post-mortems. The following December, four more, three Ayrshires and one Guernsey, were disposed of by death for the same reason, making in all up to date nineteen herds.

Of the imported Guernseys, three cows and the bull were killed, one cow died from the effects of calving, and one remains. Previous to bringing the Guernseys to the farm the

stock was all Ayrshire, and there is no history of a sick animal other than due to calving.

OUTBREAK LENOX AND STOCKBRIDGE LAND CO.
LENOX FURNACE, MASS., Oct. 30, 1888.

J. F. WINCHESTER, D. V. S.

DEAR SIR:—In reply to yours of 27th, would say, we have killed thirty-two head of cattle, all showing conclusive evidence of having tuberculosis. This comprises the entire herd. The stables have stood empty since some time in June, and have been thoroughly washed with a solution of crude carbolic acid, and afterward whitewashed.

On Nov. 15, 1887, eight cows and heifer were sent here from Palmer, Mass., one of which was a mere skeleton, very weak, coughed hard whenever moved, coughing up quantities of soft yellow matter. She stayed with the other cattle for three weeks or more, and was then condemned by a veterinary surgeon and ordered killed. Along in March I noticed several of the other cows coughing, and by the 1st of May most of the cows were coughing and losing flesh rapidly, although well fed, and before long not an animal was exempt. Numbers of them (eight, I think) were opened by Dr. Geo. N. Kinnell of Pittsfield, and all killed were slaughtered after being condemned by him. We killed twenty cows, three yearling heifers, one yearling bull and eight calves. Ten of the cows were five years old or over, twelve animals under two years old, all but one high-grade Jersey or thoroughbred Jersey. So far as I noticed, the age had little to do with the severity of the disease, as calves of two or three weeks would cough quite as hard as the cows. Many of them, old and young alike, got so sore from coughing that they seemed to suffer greatly from each attack. The cattle were fed through the winter on ensilage in morning, hay at noon, and ensilage at night. Wheat middlings fed on ensilage twice per day. Were turned out to water once each day. When once the disease got started with a cow, she would eat everything within reach,—weeds, stubs and all,—and she was constantly hungry. One cow was killed within a few days of calving, and the lymphatic glands and the intestines of the calf in others were plainly blotched by forming tubercles. I am not sure that I have answered your questions as fully as you may desire, but will cheerfully give further information at any time.

Yours truly,

HENRY J. WASHBURN,
Agent Lenox and Stockbridge Land Co.

LENOX FURNACE, MASS., Dec. 12, 1888.

J. F. WINCHESTER, D. V. S.

DEAR SIR:—At the time of the arrival of the cows from Palmer this farm had twenty cows and three yearlings on it. In former years it commonly carried forty to sixty head of all ages, but owing to a change of ownership in May, 1887, the number had been reduced. I was born

and brought up on this place, as well as were my father and grandfather, and I never knew of or heard of the existence of a case of tuberculosis in the town until the arrival of one from Palmer in November, 1887, and can therefore safely say that none ever existed here before.

Yours truly,

HENRY J. WASHBURN.

During the year 1885 Mr. C. S. Emerton of Peabody re-stocked his farm, having during the previous year sold all the cattle then on the farm. He would occasionally have a cow run down, and dispose of her, but gave little or no heed to the trouble. During the fall of 1887 several failed in their milking qualities, and did not clean after calving. This led to an examination of the cows, and tuberculosis was found to exist. Those that presented the symptoms of this disease had been in the herd from a few months to as many years. Not responding to the grain given them, and gradually losing flesh, nineteen mature cows and all the calves raised on the farm were killed, and an examination after death showed the changes due to tuberculosis. In the spring of 1887 a bull was bought in Vermont, and in the fall he was killed, having well-marked symptoms of the disease. These animals were grade Holsteins and natives. The result of this outbreak was that all the bovines on the farm were either killed or disposed of otherwise, and his loss has been his entire herd, or forty head, during the past few years.

In the spring of 1887 Dr. J. Penniman, V. S., of Worcester, was called to a farm, and while there he noticed a cow that was coughing, thin in flesh and apparently diseased with tuberculosis. On making inquiry about her, he learned that she had been coughing quite a long time and had not done well. This led him to note the condition of the others, and in a short time he heard nearly all the rest of the herd cough. Within a few days he was called to make a post-mortem examination of an animal, and on arrival found the cow dead about which he had made inquiry, and the examination revealed general tuberculosis with phthisis. In a few weeks from this time the owner desired him to make a critical examination of all the cows on the farm, numbering seventeen head of grade Jersey, Ayrshire, Shorthorns and Devons. The result of the examination was that a two-year-

old heifer that stood beside the cow that died, had a bad cough, disease of the lungs, and enlargement of the external lymphatics, and death was recommended. Another cow, where the symptoms of the disease were very marked, was killed, and the post-mortem showed a similar condition of the internal organs as the one that died. Among the lot was a fine-looking cow, in good flesh, that was heavy with calf, and soon after calving she died from milk fever, and an examination of the lungs found them diseased and broken down in places. The rest of the herd, with one exception, were coughing with more or less lung disease, and the owner was advised to fatten them, and if inspection, after slaughter, showed them free from disease, to be sold.

Soon after this he was called to another farm to see a cow that had been ailing for some time, and she presented well-marked symptoms of tuberculosis, which an examination after death sustained, having general tuberculosis and phthisis. In about six weeks from this time another cow which had been gradually failing died, and the post-mortem showed similar lesions of tuberculosis as the first cow which was killed, only to a greater extent. A third one was soon killed for the same trouble, and in the barn where these three had been kept nearly all were coughing, although they had the general appearance of health.

Another case of interest is of a gentleman in Worcester who kept a cow or two to supply his own family with milk, and also some of his neighbors. He had been supplying himself and neighbors for a year or so when he called the veterinarian to one of these cows. The doctor found a mature animal, thin in flesh, temperature 104 degrees F., unmistakable lung lesions, coughing, hurried respiration, but with a good appetite, and giving a good quantity of milk. Death was recommended, and autopsy showed tubercles in all stages of development in the lungs. In about one year was again called to the same barn to see a cow which was showing similar symptoms, and she was a daughter to the one alluded to above. She was killed, and autopsy showed similar conditions as the dam. A year or two more passed away and the doctor was sent for again, and another was found with the same symptoms as the two preceding ones; this one a

descendant of one of the others that were killed. The owner was selling the milk as usual for the children of the neighborhood, and he must have been aware that his course was little less than criminal, as he had been told the nature of the disease. He promised to have this cow killed, but he sold her for fifteen dollars to a gentleman some twelve miles out of the city, as a wet nurse for thoroughbred calves. The doctor sent word to the gentleman of the possible results if he persisted in feeding that cow's milk to calves, and again recommended death. Some months after this it was learned that the cow was not killed, but again sold for fifteen dollars, and soon after this she began to run down so fast that she was sold for the last time as a live animal for fifteen dollars to a Worcester firm, to be manufactured into bologna sausages.

The doctor cites a case of a herd of thoroughbred Jerseys within seventeen miles of Worcester, where the entire herd was killed and buried, and the barn thoroughly cleansed and disinfected. Although he does not believe it affects every herd within a radius of ten miles of Worcester, he has occasionally found it not only in the city but in almost every adjoining town; and he has no doubt but that it lurks insidiously in many a herd, and perhaps the owners may be ignorant of the fact, but he is quite sure some know they have it and keep very still.

HERD.	Bovines on Farm.	Killed.	Suspicious.	Percentage Killed.
No. 1,	70	8	8	11.42
2,	2	2	–	100.00
3,	57	5	–	8.77
4,	50	1	8	2.00
5,	12	1	3	8.33
6,	12	2	1	16.66
7,	4	1	–	25.00
8,	90	12	78	13.33
9,	34	2	3	5.88
10,	36	19	–	52.91
11,	32	32	–	100.00
12,	61	1	36*	1.65
13,	14	8	–	57.14
14,	5	2	3	40.00

* Eleven otherwise disposed of.

Herd.	Bovines on Farm.	Killed.	Suspicious.	Percentage Killed.
No. 15,	4	4	–	100.00
16,	7	2	5	28.57
17,	30	4	2	13.33
18,	5	4	1	80.00
19,	25	7	2	28.01
20,	35	6	–	17.18
21,	2	1	–	50.00
22,	1	1	–	100.00
23,	1	1	–	100.00
24,	8	3	–	37.67
25,	28	4	–	14.28
26,	30	4	–	13.33
27,	44	30	14*	68.49
28,	23	6	–	25.84
29,	17	5	–	29.41
30,	2	1	–	50.00
31,	17	4	12	28.52
32,	48	6	3	12.50
33,	40	30	10*	75.00
34,	20	20	–	100.00

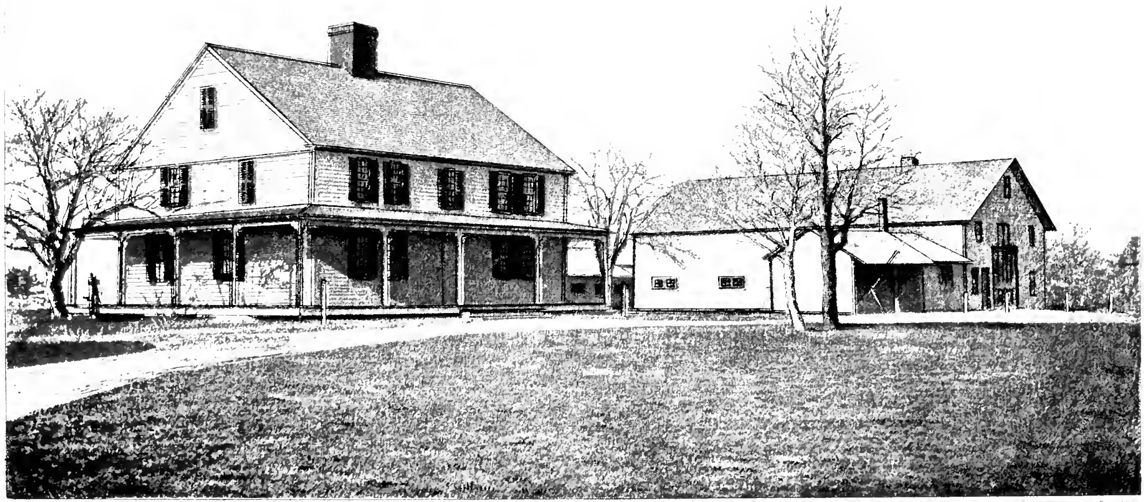
* Disposed of otherwise.

Herd.	Bovines on Farm.	Symptoms of Disease, but none Killed.	Suspicious.	Percentage that showed Symptoms of Disease but none Killed.
No. 1,	24	2	–	8.33
2,	13	2	–	15.38
3,	12	1	–	8.33
4,	8	–	–	–
5,	38	1	2	2.63
6,	15	2	1	13.33
7,	11	2	6	18.18
8,	7	–	–	–
9,	30	2	3	6.66
10,	28	2	3	7.14
11,	15	1	–	6.66
12,	11	2	2	18.88
13,	12	6	2	50.00
14,	3	2	1	66.00
15,	17	3	4	17.66

J. F. WINCHESTER, D. V. S.

Note.— The writer has been indebted to Dr. Koch, Dr. Fleming and Dr. Walley, for certain of the facts presented in the foregoing.

Barn and Feeding Stalls of the Experiment Station.



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Chemical Laboratory of the Massachusetts State Agricultural Experiment Station.

Amherst, Mass.

SIXTH ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

Gentlemen: — The past year has been, for several reasons, an eventful one in the history of the Massachusetts State Agricultural Experiment Station. The State Legislature of 1888 has passed two acts affecting the organization and the work of the Station. The membership of the Board of Control has been increased, and the management of the new regulations for the trade in commercial fertilizers has been assigned to the director of the Station. The Board of Control has also assumed the responsibility of attending to all the chemical work called for in connection with investigations instituted in the various departments of the Hatch Experiment Station, reserved by the authorities of the Massachusetts Agricultural College. The terms agreed to by the Board of Trustees of the college and the Board of Control of the Massachusetts Experiment Station allow five thousand dollars of the Hatch fund for that work. The character of the additional work, as well as the increase in financial resources, has rendered some change in the working force of the Station advisable. To meet the growing demand for assistance in adopted lines of investigation, a department of vegetable physiology has been organized with a view to assist in particular in the investigation of diseases of plants by microscopic observations and otherwise. Prof. James Ellis Humphrey of North Weymouth, Mass., a graduate of Lawrence Scientific School, Harvard University,

late professor of botany at the University of Indiana, Bloomington, Ind., was elected to the professorship of vegetable physiology, and entered upon his duties Nov. 1, 1888. A desirable increase of assistance in the chemical department of the Station for the coming year will be provided by some members of the senior class of the Agricultural College, who are already in training at the Station.

The work carried on during the past year has been in the main in three directions, namely: to determine the cost of food for the production of milk and pork, field experiments with different kinds of farm crops, and chemical examinations of a variety of substances of interest to farmers. The results of the season are, on the whole, quite satisfactory. Unfavorable weather during a considerable part of summer and autumn interfered at times, somewhat, with a more general success in field experiments, yet not in a sufficient degree to question seriously the previous statement.

The chemical laboratory has received a valuable addition of necessary apparatus. The library of the Station has been enriched by the addition of books and journals needed for reference in the special lines of investigations instituted. The stalls for feeding experiments have been enlarged in the direction pointed out in the preceding annual report. Most of the farm buildings are, as far as circumstances permit, in a good state of preservation; some of them, however, need a new coat of paint.

The chemical examinations in the laboratory have been in various directions, and exceptionally numerous. Fodder articles, fertilizers, products as well as refuse materials of various industries, have been tested with reference to their agricultural value. Much work has been done to determine the sanitary conditions of water supply in small towns and on farms. The resources of the chemical department have been engaged to their full capacity to meet the growing call for assistance on the part of our farming community.

The work for the improvement of the farm lands has been continued. Drill culture has been largely adopted for the renovation of the lands, and green manuring has extensively served to develop and economize inherent sources of plant food. The area prepared for future field experiments has

been enlarged in various parts of the farm. From nine to ten acres of permanent grass land have been added to our fodder sources. Every field of the farm has been made to contribute, as far as practicable, to that end. A detailed description of the work carried on in the different parts of the farm will be found in the accompanying report.

The buildings for stock feeding have been considerably enlarged for the purpose of inaugurating experiments regard ing the cost of feed for the production of mutton and beef. The general arrangement for serving the feed has been improved with a view to enter, whenever advisable, upon experiments to study the rate of digestibility of fodder plants peculiar to American farm industry. The live stock of the Station consists at present of two horses, six cows, two steers, six sheep and nine pigs. All, with the exception of the horses, serve at present in experiments to ascertain the cost of feed for the production of milk or meat.

The details of the work carried on in the barn, the field and the laboratory, during the past year, are recorded in the subsequent pages, under the following headings: -

Feeding Experiments.

I. Experiments with milch cows; English hay, corn stover, fodder corn, ensilage, corn and cob meal, wheat bran and gluten meal.

II. Experiments with milch cows; green fodder, vetch and oats, Southern cow-pea, corn meal, wheat bran and gluten meal.

III. Experiments with pigs; skim milk, corn meal, corn and cob meal, gluten meal and wheat bran.

IV. On fodder supply and analyses of fodder articles.

Field Experiments.

V. Fodder corn raised with single articles of plant food.

VI. Fodder crops raised with and without complete manure.

VII. Experiments with vetch and oats, serradella and Southern cow-pea.

VIII. Experiments with potatoes, roots and miscellaneous crops.

IX. "Potato Scab," by Prof. James Ellis Humphrey.

Work in the Chemical Department.

X. Fertilizer laws and fertilizer analyses; miscellaneous analyses.

XI. Water analyses.

XII. Compilation of analyses of fodder articles, with reference to food value.

XIII. Compilation of analyses of fodder articles, with reference to fertilizing ingredients.

XIV. Compilation of analyses of agricultural chemicals and refuse materials used for fertilizing purposes.

XV. Meteorological observations.

The periodical publications of the Station have been continued at such intervals as circumstances advise. The public interest in the bulletins and annual reports is steadily increasing. The State authorities have authorized the publication of twenty-five thousand copies of the annual report; and the call for our bulletins has necessitated the printing of nine thousand copies, with a prospect of the need of ten thousand in the near future. The obligation imposed upon the director of the Station by the new laws for the regulation of the trade in commercial fertilizers, to issue, during a large part of the year, a monthly statement of analyses of fertilizers made under his direction, will materially increase the periodical publication. It appears advisable in the interest of economy to publish the analyses of fertilizers as far as practicable in the form of business circulars, and to reserve the discussion of experimental work to the periodical bulletins.

All parties engaged with me in the work of the Station have faithfully attended to the tasks assigned to them; and it is with particular pleasure that I publicly recognize that fact.

I cannot consider my whole duty on this occasion fulfilled without expressing my sincere thanks to you for your kind support during the past year.

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts Agricultural Experiment Station.

AMHERST, MASS., Jan. 9, 1889

ON FEEDING EXPERIMENTS.

1888.

I. Feeding Experiments with Milch Cows; English Hay, Corn Stover, Fodder Corn, Corn Ensilage, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

II. Feeding Experiments with Milch Cows; Green Fodder, Vetch and Oats, Southern Cow-pea, Hay, Rowen, Corn Meal, Wheat Bran and Gluten Meal.

III. Feeding Experiments with Pigs; Skim Milk, Corn Meal, Corn and Cob Meal, Gluten Meal and Wheat Bran.

I. Feeding Experiments with Milch Cows; English Hay, Corn Stover, Fodder Corn, Corn Ensilage, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

During the year 1886 a series of feeding experiments with milch cows was inaugurated for the purpose of comparing the feeding effects of dry corn fodder, of corn ensilage and of corn stover, as a substitute in whole or in part for English hay; and that of corn ensilage, as compared with various kinds of roots, as far as practicable, under corresponding circumstances. The same variety of corn, if not otherwise specified, served for each trial. The corn ensilage used on these occasions has been produced in every instance from a corn crop of the same advanced state of maturity as the one which furnished the dry corn fodder, *i. e.*, at the beginning of the glazing over of the kernels.

The daily diet of the cows consisted, at the beginning of the experiment, of three and one-quarter pounds of corn meal, an equal amount of wheat bran, and all the hay they could eat. This combination of fodder articles was adopted as the basis of our investigation mainly for the reason that

it had been used in some of our earlier feeding experiments, and not on the assumption of its being the best possible combination of fodder articles for milch cows. The actual amount of hay consumed in each case was ascertained by weighing out a liberal supply of it and deducting subsequently the hay left over. The statement made in our records in this connection refers to the average consumption of hay per day during the feeding period.

The temporary changes in the diet, whenever decided upon, were carried out gradually, as it is customary in all carefully conducted feeding experiments. At least five days are allowed in every instance to pass by, in case of a change in the character of the feed, before the daily observations of the results appear in our published records. The dates which accompany all detailed reports of our feeding experiments, past and present, furnish exact figures in that direction. This is in particular the case whenever such statements are of a special interest for an intelligent appreciation of the final conclusions presented. The weights of the animals were taken on the same day of each week, before milking and feeding.

The valuation of the various fodder articles consumed was based on the average local market price per ton in Amherst, 1886–1887 : —

Good English hay, .	$15 00	Rye middlings, . .	$24 00
Corn meal, ...	23 00	Dry corn fodder (stover),	5 00
Wheat bran, ...	20 00	Corn ensilage, . . .	2 75
Gluten meal, ...	23 00	Carrots, ...	7 00

To assist those not yet familiar with the various points which ought to be taken into consideration when deciding the relative agricultural value of fodder articles at our disposal, the following short discourse on this subject, from the preceding annual report, is here reprinted. The value of a fodder for dairy purposes may be stated from two distinctly different stand-points : namely, with reference to its influence on the temporary yield of milk and the general condition of the animals which consume it, and in regard to its cost, *i.e.*, its physiological and commercial value. The relative commercial value of a fodder article again depends on its

first cost in the market, and on the value of the fertilizing constituents left in the manurial matter after it has served for food. The market value and actual feeding effect of one and the same article do not necessarily correspond with each other; in fact, they rarely coincide. The market value may be stated for each locality by one definite number. The feeding effect of one and the same substance, simple or compound, varies under different circumstances, and depends in a controlling degree on its judicial use in compounding diets.

1. *Physiological or Feeding Value.*

As no single plant or part of plant has been found to supply economically and efficiently, to any considerable extent, the wants of our various kinds of farm stock, it becomes a matter of first importance to learn how to supplement our leading farm crops to meet the divers wants of each kind. To secure the highest feeding value of each article of fodder is most desirable in the interest of good economy. The judicious selection of ingredients for a suitable and remunerative diet for our dairy stock obliges us, therefore, to study the value of fodder articles at our disposal from both standpoints.

To ascertain the chemical composition of a fodder ration, in connection with an otherwise carefully managed feeding experiment, enables us to recognize with more certainty the causes of the varying feeding effects of one and the same fodder article, when fed in different combinations. It furnishes also a most valuable guide in the selection of suitable commercial feed stuffs from known sources to supplement economically our home-raised fodder crops. Practical experience in feeding stock has so far advanced that it seems to need no further argument to accept it as a matter of fact that the efficiency of a fodder ration in the dairy does not depend, aside from its general or special adaptation, on the mere presence of more or less of certain prominent fodder articles, but on the presence of a proper quantity and a certain relative proportion of certain prominent constituents of plants which are known to be essential for a successful support of life and of the special functions of the dairy cow.

Investigations into the relations which the various promi-

nent constituents of plants bear to the support of animal life have rendered it advisable to classify them, in this connection, into three groups, — mineral constituents, and nitrogenous and non-nitrogenous organic constituents. For details regarding this matter, I have to refer to previous publications of the Station. (See Fourth Annual Report, pages 31–37.)

Numerous and extensive practical feeding experiments with most of our prominent fodder articles in various conditions, and with all kinds of farm live stock, have introduced the practice of reporting, in connection with the analysis of the chemist, also the result of careful feeding experiments as far as the various fodder articles have proved digestible, and were thus qualified for the support of the life and the functions of the particular kind of animal on trial. In stating the amount of the digestible portion of the fodder consumed in a feeding experiment, it has proved useful for comparing different fodder rations, etc., to make known by a distinct record the relative proportions which has been noticed to exist between the amount of its digestible, nitrogenous and non-nitrogenous organic constituents. This relation is expressed by the name of "nutritive ratio." An examination of the description of our feeding experiments will show, for instance, that the corn meal fed (1888) contained one part of digestible nitrogenous to 9.66 parts of digestible non-nitrogenous organic matter, making the customary allowance for the higher physiological value of the fat as compared with that of starch, sugar, etc. (2.5 times higher).

The "nutritive ratios" of the articles of feed consumed in 1888 are subsequently stated as follows: —

Corn meal,	1:9.66	English hay,	1:10.52
Wheat bran,	1:3.85	Dry corn fodder,	1:10.31
Gluten meal,	1:2.11	Stover,	1: 9.3
		Corn ensilage,	1: 8.8

The results of our own analyses of these fodder articles are here turned to account for the calculation of the above-stated "nutritive ratios."

It has been noticed that, as a general rule, growing

animals and milch cows require a richer food, — *i. e.*, a closer relation of digestible nitrogenous and non-nitrogenous organic constituents in their feed, — to do their best, than full-grown animals and moderately-worked horses and oxen. German investigators recommend a combination of fodder articles, in other respects suitable, which contains one part of nitrogenous organic constituents to 5.4 parts of digestible non-nitrogenous constituents.

2. Commercial Value or Actual Cost of a Fodder Article.

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and in particular nitrogen, a fodder ingredient contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind, after it has served its purpose as a constituent of the food consumed.

As the financial success in most farm managements depends in a considerable degree on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder, and the value of the manure resulting, deserve the careful consideration of the farmer when devising an efficient and at the same time an economical diet for his live stock.

The question whether one or the other fodder mixture will prove ultimately, under otherwise corresponding circumstances, the cheapest one, can only be answered intelligently when both the original cost of the feed consumed and the value of the manurial residue subsequently obtained are duly considered.

An examination of the fodder articles used in connection with our investigations shows, for instance, the following relation between their first cost and the commercial value of their fertilizing constituents : —

	First cost.	Value of Fertilizing Constituents.
Corn meal,	$23 00	$7 19
Wheat bran,	23 00	12 31
Gluten meal,	27 00	17 49
English hay,	15 00	6 45
Corn ensilage,	2 75	1 31
Fodder corn,	5 00	4 77
Corn stover,	5 00	4 95
Carrots,	7 00	1 06
Lane's sugar beet,	5 00	1 60

A compilation of our own observations in this direction will be found at the close of our present report.

The close relation which quite necessarily exits in most farm managements between the system of cultivating the lands and the keeping of farm live stock for farm work, for the dairy and for the supply of food for the general market, imparts to the barn-yard manure a special if not a controlling importance as a valuable manurial resource. The barn-yard manure ought to remain, in a judicious system of mixed farming, not only the main reliance of the farmer for plant food, but also the cheapest manure at his disposal. The objections raised at times against a liberal use of barn-yard manure ought not to rest on its higher cost of production, when compared with other manurial substances in our market. The name, "barn-yard manure," is, however, too frequently used without any particular discrimination with reference to all kinds of manurial refuse obtained in connection with stock feeding and stock raising, which are frequently of widely differing composition. To approximate even fairly the comparative value of two samples obtained on different farms remains a hopeless task as long as a more definite information regarding the following points is wanting: —

(1.) The character of the fodder consumed.

(2.) The kind, the age and the function of the animal which served for its production.

(3.) The nature and the quantity of the material which served for the absorption of the animal excretions.

(4.) The care bestowed upon collecting and preserving the entire liquid and solid excretions.

Assuming, for our present purpose, in both instances, identical conditions, as far as the kind of animal, the mode of collecting and the care of keeping the manure are concerned, it will be apparent that the relative values of the two kinds of barn-yard manure stand essentially in a direct relation to the amount of nitrogen, potash, phosphoric acid, etc., which was contained in the feed consumed.

The loss of fertilizing constituents contained in the fodder of milch cows, in consequence of the production of milk, varies quite naturally more or less in case of different cows, as well as of one and the same animal at its different stages of milk production. Whether the whole milk or only the cream is sold off from the farm deserves here not less serious consideration.

We have adopted thus far in our calculation a loss of twenty per cent., which may be considered quite a liberal allowance in case of a fair average production of milk, and where the whole milk is sold.

1886. — From the description of our earlier feeding experiments with milch cows (see Fourth Annual Report, page 11), it may be observed that the relations of the digestible nitrogenous and non-nitrogenous organic constituents in the different combinations of fodder articles which constituted, during the various feeding periods, the daily diet of the cows, varied on that occasion from 1 : 6.7 to 1 : 10.17. The closer relation was obtained by feeding, on an average, daily, —

3¼ lbs. of wheat bran, 15 lbs. of hay, 40 lbs. of Lane's sugar beet,	Nutritive ratio, 1 : 6.7.

and the wider ratio by feeding daily, on an average, —

3¼ lbs. of corn meal, 5 lbs. of hay, 41¾ lbs. of corn ensilage,	Nutritive ratio, 1 : 10.17.

1887. — As most well-conducted experiments with dairy cows endorse the use of a diet which has a closer relation

between its digestible organic nitrogenous and non-nitrogenous constituents than either one of the above-stated two fodder rations used by us, it was decided to try fodder combinations which, in consequence of the addition of some concentrated commercial fodder article, would contain a larger amount of digestible nitrogenous substances. The gluten meal was selected for that purpose. The same coarse fodder articles — English hay, corn ensilage, corn stover and roots (carrots) — were used in most cases in different quantities and combinations with equal weights of corn meal, wheat bran and gluten meal. The relations between the two above-stated important groups of fodder constituents varied in the different diets used from 1 : 5.9 to 1 : 7.9. The closer relation was obtained by feeding daily, on an average, —

$$\left.\begin{array}{rl} 3\frac{1}{4} & \text{lbs. of corn meal,} \\ 3\frac{1}{4} & \text{lbs. of wheat bran,} \\ 3\frac{1}{4} & \text{lbs. of gluten meal,} \\ 10 & \text{lbs. of hay,} \\ 35 & \text{lbs. of carrots,} \end{array}\right\} \text{Nutritive ratio, } 1:5.9.$$

and the wider ratio by feeding, on an average, —

$$\left.\begin{array}{rl} 3\frac{1}{4} & \text{lbs. of corn meal,} \\ 3\frac{1}{4} & \text{lbs. of wheat bran,} \\ 25 & \text{lbs. of hay,} \end{array}\right\} \text{Nutritive ratio, } 1:7.9.$$

The entire feeding experiment (I) was subdivided into eight distinctly different feeding periods; the same number as on the preceding occasion, for the same length of time — seven months.

The dry corn fodder, the ensilage and the roots were cut before being offered as feed.

The yield of milk decreased, although at a different rate, in the case of different animals as time advanced. The shrinkage in the daily yield of milk amounted, at the end of the experiment, to from 3.2 quarts to 4.9 quarts in case of different cows. The gradual decline in the entire milk record of every cow is only once broken, namely, during the sixth feeding period, February 7 to February 21, when the yield of milk shows an increase of from .7 to 1.9 quarts per day, as compared with that of the preceding period. This change for the better was noticed when ten pounds of

hay and thirty-four pounds of carrots were used, under otherwise corresponding circumstances, as a substitute for five pounds of hay and twenty-nine pounds of corn ensilage. The amount of dry vegetable matter contained in the hay fed with roots and in the hay fed with corn ensilage was practically the same in both instances. The feed of the sixth feeding period, containing carrots as an ingredient, is thus the most nutritive and also the most expensive.

The results of the experiment led us to the following conclusions: —

The nutritive value of our dry corn fodder (stover) compares well with that of an average quality of English hay; the same may be said of good corn ensilage in place of from one-half to two-thirds of the customary amount of hay.

The nutritive value of our dry corn fodder (stover) and of a good corn ensilage, taking into consideration pound for pound of the dry vegetable matter they contain, has proved in our case fully equal, if not superior, to that of the average English hay.

The nutritive feeding value of carrots, taking into consideration pound for pound of the dry vegetable matter they contain, exceeds that of the corn ensilage as an ingredient of the daily diet, in place of a part (one-half) of the hay fed. The conclusions thus far stated are in full agreement with those pointed out in our earlier experiments.

The influence of the various diets used on the quality of the milk seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet.

The total cost of the feed for the production of milk is lowest whenever corn fodder or corn ensilage have replaced, in the whole or in part, English hay, under otherwise corresponding circumstances.

The net cost of feed consumed for the production of one quart of milk during the various feeding periods, varies as widely as from .34 cents to 1.6 cents in case of the same cow. The net cost of the feed is obtained by deducting eighty per cent. of the value of the fertilizing constituents it contains.

The manurial value of the feed consumed during the entire feeding experiment, deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is, at the current market rates, in every instance, more than equal to one-third of the original cost of the feed.

To avoid misconstruction regarding the statement of net cost of milk used in our description, I state once more that it does not include expenses of labor, housing, interest on investment, etc., but means merely net cost of feed after deducting eighty per cent. of its manurial value. (For details, see Fifth Annual Report, pages 11–34.)

1888. — To verify as far as practicable the above-stated conclusions, a new series of observations was decided upon. The course adopted was essentially the same as in the preceding year. English hay, fodder corn, corn ensilage and corn stover served as coarse fodder articles; and corn meal, corn and cob meal, wheat bran and gluten meal as the supplementary feed stuffs to secure the desired relative proportion of digestible nitrogenous and non-nitrogenous substances in the daily fodder rations. The repetition of a comparative test between roots and corn ensilage was left over for another season, when a larger supply of sugar beets and carrots would render the trial more decisive. The fodder corn, corn ensilage and corn stover were cut to an even length ($1\frac{1}{2}$–2 inches) before fed. The daily average amount of fodder corn left behind unconsumed was 5.55 pounds and that of corn stover and ensilage, 3 pounds.

Six cows, grades, served in the experiment, which was subdivided into seven feeding periods, extending over a period of four and one-half months. The same quantity of corn and cob meal, wheat bran and gluten meal (three and one-quarter pounds each) was fed daily from the beginning to the close of the trial. Corn ensilage was fed in different proportions with one-half or one-fourth of English hay. Fodder corn and corn stover were fed most of the time by themselves.

The nutritive value of the different diets used has been quite close, varying from 1:5.5 to 1:6.1. The adopted rates of digestibility of the fodder ingredients are those which have been published of late by E. Wolff. They are

in most instances the average values of a series of actual tests, and are for this reason applicable for mere economical questions. As soon as our home observations shall have furnished sufficient material to enable us to establish reliable average values, they will be substituted.

Local Market Value of Feed used in our Calculations.

Corn meal,	$23 00	English hay,	$15 00
Corn and cob meal,	20 70	Fodder corn,	5 00
Wheat bran,	23 00	Corn ensilage,	2 75
Gluten meal,	27 00	Corn stover,	5 00

An examination of the subsequent tabular statement of the details of the late experiment cannot fail to show that the conclusions drawn from our preceding observation in this direction are in the main fully sustained.

The high nutritive value of fodder corn, good corn ensilage and corn stover, as compared with that of English hay, counting in all instances pound for pound of dry vegetable matter, is fully confirmed. The general condition of the animals on trial, as well as the quality of the milk, point in that direction.

The daily yield of milk decreased gradually, apparently at a normal rate, during the progress of the experiment. The shrinkage in the yield of milk amounted, at the close of the trial, in the case of different cows of different milking periods, to from 1.6 to 4 quarts per day. The weight of the cows had decreased in three cases, and had increased in three.

The first cost of feed for the production of one quart of milk in case of the same cow, is, as a rule, from one-half to one cent less per quart wherever fodder corn, corn ensilage or corn stover have replaced in part or in whole the English hay. The first cost of feed for the production of one quart of milk differs, for obvious reasons, quite seriously in case of the same diet as far as different animals are concerned. This difference stands in a direct relation to the daily yield of milk; the less the latter, the higher the cost of the feed. A few results taken from our subsequent records may convey some more definite idea regarding this important circumstance.

Fodder rations:	Fodder corn,	18–19 lbs.
	Corn and cob meal,	$3\frac{1}{4}$ lbs.
	Wheat bran,	$3\frac{1}{4}$ lbs.
	Gluten meal,	$3\frac{1}{4}$ lbs.

	Daily Yield of Milk.	First cost of feed.	Net cost of feed.
Daisy,	17.5 qts.	1.01 cts. per qt.	.50 cts. per qt.
Melia,	12.7 "	1.28 " "	.66 " "
Eva,	6.1 "	2.64 " "	1.39 " "

Fodder rations:	English hay,	20 lbs.
	Corn and cob meal,	$3\frac{1}{4}$ lbs.
	Wheat bran,	$3\frac{1}{4}$ lbs.
	Gluten meal,	$3\frac{1}{4}$ lbs.

	Daily Yield of Milk.	First cost of feed.	Net cost of feed.
Daisy,	13.5 qts.	1.97 cts per qt.	1.28 cts. per qt.
Melia,	10.9 "	2.44 " "	1.59 " "
Eva,	5.6 "	4.74 " "	3.09 " "

The net cost of feed is obtained by deducting eighty per cent. of the commercial value of the fertilizing constituents it contains from its first cost. The manurial value of the feed consumed during the feeding experiments, after deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is at current market prices in every instance more than one-third of the original cost of the feed.

For further details, consult the following record: —

FEEDING RECORD.

MAY: *Age, 7 years; Grade, Jersey; Last Calf, June 6, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16,	3.25	–	3.25	3.25	18.89	–	–	–	25.49	10.8	2.36	1 : 6.1	845
Jan. 21 to Feb. 6,	–	3 25	3.25	3.25	20.00	–	–	–	26.46	12.3	2.15	1 : 5.9	862
Feb. 13 to Feb. 26,	–	3.25	3.25	3.25	–	20.41	–	–	23.95	11.0	2.18	1 : 6.2	825
March 1 to March 13,	–	3.25	3.25	3.25	10.00	–	21.71	–	22.48	11.6	1.94	1 : 5.6	848
March 20 to April 4,	–	3.25	3.25	3.25	5.00	–	36.78	–	21.45	10.6	2.02	1 : 5.5	828
April 20 to April 30,	–	3.25	3.25	3.25	–	–	–	13.98	19.93	10.1	1.97	1 : 5.5	820
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.6	2.50	1 : 5.9	862

MINNIE: *Age, 8 years; Grade, Ayrshire; Last Calf, May 3, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16,	3.25	–	3.25	3.25	18.86	–	–	–	25.47	12.0	2.12	1 : 6.1	993
Jan. 21 to Feb. 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	12.7	2.08	1 : 5.9	993
Feb. 13 to Feb 26,	–	3.25	3.25	3.25	–	17.71	–	–	21.93	11.3	1.94	1 : 5.9	960
March 1 to March 13,	–	3.25	3.25	3.25	10.00	–	21.71	–	22.48	12 1	1.86	1 : 5 6	955
March 20 to April 4,	–	3 25	3.25	3.25	5.00	–	29.45	–	19.78	10.9	1.81	1 : 5.4	949
April 20 to April 30,	–	3.25	3.25	3.25	–	–	–	11.20	17.68	10.2	1.73	1 : 5.2	870
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.5	2.52	1 : 5.9	862

FEEDING RECORD — *Continued.*

MELIA: *Age, 10 years; Grade, Dutch; Last Calf, Aug. 5, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16,	3.25	–	3.25	3.25	18.33	–	–	–	24.99	13.5	1.85	1 : 6.1	993
Jan. 21 to Feb. 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	14.6	1.81	1 : 5.9	995
Feb. 13 to Feb. 26,	–	3.25	3.25	3.25	–	18.93	–	–	22.84	12.7	1.80	1 : 6.0	954
March 1 to March 13,	–	3.25	3.25	3.25	10.00	–	21.78	–	22.50	12.5	1.80	1 : 5.6	973
March 20 to April 4,	–	3.25	3.25	3.25	5.00	–	32.05	–	20.37	11.8	1.73	1 : 5.5	936
April 20 to April 30,	–	3.25	3.25	3.25	–	–	–	13.75	19.75	11.2	1.76	1 : 5.5	925
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.9	2.43	1 : 5.9	969

EVA: *Age, 8 years; Grade, Jersey; Last Calf, Jan. 6, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 6 to Jan. 16,	3.25	–	3.25	3.25	18.89	–	–	–	25.49	7.0	3.64	1 : 6.1	988
Jan. 21 to Feb. 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	7.2	3.68	1 : 5.9	1,008
Feb. 13 to Feb. 26,	–	3.25	3.25	3.25	–	18.19	–	–	22.29	6.1	3.65	1 : 6.0	997
March 20 to April 4,	–	3.25	3.25	3.25	5.00	–	31.80	–	20.32	5.5	3.69	1 : 5.4	1,022
April 20 to April 30,	–	2.35	3.25	3.25	–	–	–	13.02	19.16	5.7	3.36	1 : 5.5	1,055
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.16	5.6	4.73	1 : 5.9	1,143

FEEDING RECORD — *Concluded.*

LIZZIE: *Age, 6 years; Native; Last Calf, Feb. 1, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16,	3.25	–	3.25	3.25	18.31	–	–	–	25.08	9.4	2.67	1 : 6.1	1,045
Jan. 21 to Feb. 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.6	2.50	1 : 5.9	1,055
Feb. 13 to Feb. 26,	–	3.25	3.25	3.25	–	20.18	–	–	23.74	8.2	2.90	1 : 6.1	1,037
March 1 to March 13,	–	3.25	3.25	3.25	10.00	–	18.92	–	21.85	9.2	2.38	1 : 5.5	1,040
March 20 to April 4,	–	3.25	3.25	3.25	5.00	–	26.42	–	19.09	8.6	2.22	1 : 5.3	1,073
April 20 to April 30,	–	3.25	3.25	3.25	–	–	–	12.70	18.90	8.7	2.17	1 : 5.4	1,055
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	7.9	3.35	1 : 5.9	1,091

DAISY: *Age, 5 years; Grade, Durham; Last Calf, Jan. 5, 1888.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 21 to Feb. 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	19.2	1.38	1 : 5.9	1,148
Feb. 13 to Feb. 26,	–	3.25	3.25	3.25	–	25.00	–	–	27.40	17.5	1.56	1 : 6.5	1,102
March 1 to March 13,	–	3.25	3.25	3.25	10.00	–	34.46	–	25.38	17.0	1.49	1 : 5.8	1,068
March 20 to April 4,	–	3.25	3.25	3.25	5.00	–	47.36	–	23.86	14.3	1.67	1 : 5.8	1,084
April 20 to April 30,	–	3.25	3.25	3.25	–	–	–	15.32	21.02	13.6	1.55	1 : 5.7	1,100
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	13.5	1.96	1 : 5.9	1,102

TOTAL COST OF FEED PER QUART OF MILK.

May.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	97.2	10.8	29.25	–	29.25	29.25	170.01	–	–	–	$2 34	2.41
Jan. 21 to Feb. 6, . .	209.1	12.3	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.16
Feb. 13 to Feb. 26, . .	154.0	11.0	–	45.50	45.50	45.50	–	285.74	–	–	2 33	1.51
March 1 to March 13, . .	162.4	11.6	–	42.25	42.25	42.25	130.00	–	282.23	–	2 87	1.77
March 20 to April 4, . .	169.6	10.6	–	52.00	52.00	52.00	80.00	–	588.48	–	3 26	1.93
April 20 to April 30, . .	111 1	10.1	–	35.75	35.75	35.75	–	–	–	143.22	1 65	1.59
May 9 to May 15, . .	74.2	10.6	–	22.75	22.75	22.75	140.00	–	–	–	1 86	2.51

Minnie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 8 to Jan. 16, . .	108.0	12.0	29.25	–	29.25	29.25	169.74	–	–	–	$2 34	2.17
Jan. 21 to Feb. 6, . .	215.9	12.7	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.09
Feb. 13 to Feb. 26, . .	158.2	11.3	–	45.50	45.50	45.50	–	247.94	–	–	2 23	1.41
March 1 to March 13, . .	157.3	12.1	–	42.25	42.25	42.25	130.00	–	282.23	–	2 87	1.82
March 20 to April 4, . .	174.4	10.9	–	52.00	52.00	52.00	80.00	–	471.20	–	3 10	1.78
April 20 to April 30, . .	112.2	10.2	–	35.75	35.75	35.75	–	–	–	139.70	1 57	1.40
May 9 to May 15, . .	73.5	10.5	–	22.75	22.75	22.75	140.00	–	–	–	1 86	2.53

TOTAL COST OF FEED PER QUART OF MILK — Continued.

Melia.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	121.5	13.5	29.25	–	29.25	29.25	164.97	–	–	–	$2 30	1.89
Jan. 21 to Feb. 6, . .	248.2	14.6	–	55.25	55.25	55.25	340.00	–	–	–	4 51	1.82
Feb. 13 to Feb. 26, . .	177.8	12.7	–	45.50	45.50	45.50	–	265.02	–	–	2 27	1.28
March 1 to March 13, . .	162.5	12.5	–	42 25	42.25	42.25	130.00	–	283.14	–	2 87	1.77
March 20 to April 4, . .	188.8	11 8	–	52.00	52.00	52.00	80.00	–	512.80	–	3 16	1.67
April 20 to April 30, . .	123.2	11 2	–	35.75	35.75	35.75	–	–	–	168.52	1 74	1.33
May 9 to May 15, . .	76.3	10.9	–	22.75	22.75	22.75	140.00	–	–	–	1 86	2.44

Eva.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 8 to Jan. 16, . .	63.0	7.0	29.25	–	29.25	29.25	170.01	–	–	–	$2 34	3.71
Jan. 21 to Feb. 6, . .	122.4	7.2	–	55.25	55.25	55.25	340.00	–	–	–	4 51	3.68
Feb. 13 to Feb. 26, . .	85.1	6.1	–	45.50	45.50	45.50	–	254.66	–	–	2 25	2.64
March 20 to April 4, . .	88.0	5.5	–	52.00	52.00	52.00	80.00	–	508.80	–	3 15	3.58
April 20 to April 30, . .	62 7	5.7	–	35.75	35.75	35.75	–	–	–	153.78	1 62	2.58
May 9 to May 15, . .	39.2	5.6	–	22.75	22.75	22.75	140.00	–	–	–	1 86	4.74

TOTAL COST OF FEED PER QUART OF MILK — Concluded.

Lizzie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16,	84.6	9.4	29.25	–	29.25	29.25	164.79	–	–	–	$2 30	2.72
Jan. 21 to Feb. 6,	180.2	10.6	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.50
Feb. 13 to Feb. 26,	114.8	8.2	–	45.50	45.50	45.50	–	282.52	–	–	2 32	2.02
March 1 to March 13,	119.6	9.2	–	42.25	42.25	42.25	130.00	–	245.96	–	2 81	2.35
March 20 to April 4,	137.6	8.6	–	52.00	52.00	52.00	80.00	–	422.72	–	3 03	2.20
April 20 to April 30,	95.7	8.7	–	35.75	35.75	35.75	–	–	–	123.20	1 61	1.68
May 9 to May 15,	55.3	7.9	–	22.75	22.75	22.75	140.00	–	–	–	1 86	3.36

Daisy.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 21 to Feb. 6,	326.4	19.2	–	55.25	55.25	55.25	340.00	–	–	–	$4 51	1.38
Feb. 13 to Feb. 26,	245.0	17.5	–	45.50	45.50	45.50	–	350.00	–	–	2 49	1.01
March 1 to March 13,	221.0	17.0	–	42.25	42.25	42.25	130.00	–	447.98	–	3 10	1.40
March 20 to April 4,	228.8	14.3	–	52.00	52.00	52.00	80.00	–	757.76	–	3 50	1.53
April 20 to April 30,	149.6	13.6	–	35.75	35.75	35.75	–	–	–	151.25	1 69	1.13
May 9 to May 15,	94.5	13.5	–	22.75	22.75	22.75	140.00	–	–	–	1 86	1.97

Summary of Net Cost of Feed for Each Cow during Succeeding Periods

PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during the Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
					Cents.	Lbs.
1. May,	$2 34	$1 03	$0 82	$1 52	1.56	860
Minnie,	2 34	1 03	82	1 52	1.41	985
Melia,	2 30	1 02	82	1 48	1.22	985
Eva,	2 34	1 03	82	1 52	2.41	985
Lizzie,	2 30	1 02	82	1 48	1.75	1,025
2. May,	4 51	1 98	1 58	2 93	1.40	880
Minnie,	4 51	1 98	1 58	2 93	1.36	1,005
Melia,	4 51	1 98	1 58	2 93	1.19	1,005
Eva,	4 51	1 98	1 58	2 93	2.39	1,030
Lizzie,	4 51	1 98	1 58	2 93	1.63	1,060
Daisy,	4 51	1 98	1 58	2 93	.90	1,145
3. May,	2 33	1 42	1 14	1 19	.77	820
Minnie,	2 23	1 33	1 06	1 17	.74	965
Melia,	2 27	1 37	1 10	1 17	.66	965
Eva,	2 25	1 34	1 07	1 18	1.39	1,010
Lizzie,	2 32	1 41	1 13	1 19	1.04	1,060
Daisy,	2 49	1 57	1 26	1 23	.50	1,105
4. May,	2 87	1 29	1 03	1 84	1.13	840
Minnie,	2 87	1 29	1 03	1 84	1.17	950
Melia,	2 87	1 29	1 03	1 84	1.13	975
Lizzie,	2 81	1 27	1 02	1 79	1.50	1,050
Daisy,	3 10	1 41	1 13	1 97	.89	1,060
5. May,	3 26	1 50	1 20	2 06	1.21	825
Minnie,	3 10	1 42	1 14	1 96	1.12	942
Melia,	3 16	1 45	1 16	2 00	1.06	897
Eva,	3 15	1 45	1 16	1 99	2.26	1,000
Lizzie,	3 03	1 39	1 11	1 92	1.40	1,045
Daisy,	3 50	1 62	1 30	2 20	.96	1,091
6. May,	1 65	93	74	91	.82	804
Minnie,	1 57	92	74	83	.74	922
Melia,	1 74	1 00	80	94	.76	935
Eva,	1 62	96	77	85	1.35	1,153
Lizzie,	1 61	88	70	91	.95	1,043
Daisy,	1 69	95	76	93	.62	1,046
7. May,	1 86	81	65	1 21	1.63	860
Minnie,	1 86	81	65	1 21	1.65	945
Melia,	1 86	81	65	1 21	1.59	972
Eva,	1 86	81	65	1 21	3.09	1,105
Lizzie,	1 86	81	65	1 21	2.19	1,087
Daisy,	1 86	81	65	1 21	1.28	1,103

SUMMARY.

May.

Total amount of milk produced during the above records (87 days),	977.6 qts.
Total cost of feed per quart of milk produced,	1.93 cts.
Manurial value left behind per quart of milk produced,	.73 cts.
Net cost per quart of milk produced,	1.20 cts.

Minnie.

Total amount of milk produced during the above records (87 days),	999.5 qts.
Total cost of feed per quart of milk produced,	1.85 cts.
Manurial value left behind per quart of milk produced,	.70 cts.
Net cost per quart of milk produced,	1.15 cts.

Melia.

Total amount of milk produced during the above records (87 days),	1,098.3 qts.
Total cost of feed per quart of milk produced,	1.70 cts.
Manurial value left behind per quart of milk produced,	.65 cts.
Net cost per quart of milk produced,	1.05 cts.

Eva.

Total amount of milk produced during the above records (74 days),	460.4 qts.
Total cost of feed per quart of milk produced,	3.42 cts.
Manurial value left behind per quart of milk produced,	1.31 cts.
Net cost per quart of milk produced,	2.11 cts.

Lizzie.

Total amount of milk produced during the above records (87 days),	787.8 qts.
Total cost of feed per quart of milk produced,	2.34 cts.
Manurial value left behind per quart of milk produced,	.90 cts.
Net cost per quart of milk produced,	1.44 cts.

Daisy.

Total amount of milk produced during the above records (78 days),	1,265.3 qts.
Total cost of feed per quart of milk produced,	1.36 cts.
Manurial value left behind per quart of milk produced,	.53 cts.
Net cost per quart of milk produced,	.83 cts.

Manurial Value of Feed.

May.

FEEDING PERIODS.	Total Cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.					Cents.	Lbs.
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	1.56	860
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.40	880
Feb. 13 to Feb. 26,	2 33	1 42	1 14	1 19	.77	820
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.13	840
Mar. 20 to Apr. 4,	3 26	1 50	1 20	2 06	1.21	825
Apr. 20 to Apr. 30,	1 65	93	74	91	.82	804
May 9 to May 15,	1 86	81	65	1 21	1.63	860
Total, . . .	$18 82	$8 96	$7 16	$11 66	–	–

Minnie.

1888.						
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	1.41	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.36	1,005
Feb. 13 to Feb. 26,	2 23	1 33	1 06	1 17	.74	965
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.17	950
Mar. 20 to Apr. 4,	3 10	1 42	1 14	1 96	1.12	942
Apr. 20 to Apr. 30,	1 57	92	74	83	.74	922
May 9 to May 15,	1 86	81	65	1 21	1.65	945
Total, . . .	$18 48	$8 78	$7 02	$11 46	–	–

Melia.

1888.						
Jan. 8 to Jan. 16,	$2 30	$1 02	$0 82	$1 48	1.22	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.19	1,005
Feb. 13 to Feb. 26,	2 27	1 37	1 10	1 17	.66	965
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.13	975
Mar. 20 to Apr. 4,	3 16	1 45	1 16	2 00	1.06	897
Apr. 20 to Apr. 30,	1 74	1 00	80	94	76	935
May 9 to May 15,	1 86	81	65	1 21	1.59	972
Total, . . .	$18 71	$8 92	$7 14	$11 57	–	–

MANURIAL VALUE OF FEED — Concluded.

Eva.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.					Cents.	Lbs.
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	2.41	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	2.39	1,030
Feb. 13 to Feb. 26,	2 25	1 34	1 07	1 18	1.39	1,010
Mar. 20 to Apr. 4,	3 15	1 45	1 16	1 99	2.26	1,000
Apr. 20 to Apr. 30,	1 62	96	77	85	1.35	1,153
May 9 to May 15,	1 86	81	65	1 21	3.09	1,105
Total, . . .	$15 73	$7 57	$6 05	$9 68	-	-

Lizzie.

1888.						
Jan. 8 to Jan. 16,	$2 30	$1 02	$0 82	$1 48	1.75	1,025
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.63	1,060
Feb. 13 to Feb. 26,	2 32	1 41	1 13	1 19	1.04	1,060
Mar. 1 to Mar. 13,	2 81	1 27	1 02	1 79	1.50	1,050
Mar. 20 to Apr. 4,	3 03	1 39	1 11	1 92	1.40	1,045
Apr. 20 to Apr. 30,	1 61	88	70	91	.95	1,043
May 9 to May 15,	1 86	81	65	1 21	2.19	1,087
Total, . . .	$18 44	$8 76	$7 01	$11 43	-	-

Daisy.

1888.						
Jan. 21 to Feb. 6,	$4 51	$1 98	$1 58	$2 93	0.90	1,145
Feb. 13 to Feb. 26,	2 49	1 57	1 26	1 23	.50	1,105
Mar. 1 to Mar. 13,	3 10	1 41	1 13	1 97	.89	1,060
Mar. 20 to Apr. 4,	3 50	1 62	1 30	2 20	.96	1,091
Apr. 20 to Apr. 30,	1 69	95	76	93	.62	1,046
May 9 to May 15,	1 86	81	65	1 21	1.28	1,103
Total, . . .	$17 15	$8 34	$6 68	$10 47	-	-

Valuation of Essential Fertilizing Constituents contained in the Variou. Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents per pound; potassium oxide, 4¼ cents per pound.

[Per cent.]

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Fodder Corn.	Hay.	Ensilage.	Corn Stover.
Nitrogen,	1.796	1.453	2.780	5.120	.995	1.250	.289	1.119
Phosphoric acid,	.744	.688	1.857	.297	.201	.464	.112	.354
Potassium oxide,	.435	.548	1 071	.030	1.465	2.085	.264	.975
Valuation per 2,000 lbs.,	$7 19	$6 09	$12 31	$17 28	$4 77	$6 45	$1 31	$4 95

Analyses of Milk.

[Per cent.]

May.

1888.	Jan. 17.	Jan. 31.	Feb. 24.	Mar. 9.	Mar. 29.	April 11.	April 24.	May 3.
Solids,	14.04	13.64	14.30	14.18	14.05	13.76	13 91	14.36
Fat,	4.13	3.64	3.91	3.55	3.95	2.64	4.18	4.71
Solids not fat,	9.91	10.00	10.39	10.63	10.10	11.12	9.73	9.65

Minnie.

Solids,	13.61	13.86	14.55	13.76	13.36	13.84	13.28	13.90
Fat,	3.68	4.21	3.90	3.65	3.54	3.43	4.33	4.62
Solids not fat,	9.93	9.65	10.65	10.11	9.82	10.41	8.95	9.28

Melia.

Solids,	12.79	13.19	13.26	12.43	12.15	13.26	13.90	13.12
Fat,	3.30	3.57	3.13	2.48	3 21	3.19	4.47	3.79
Solids not fat,	9.49	9.62	10.13	9.95	8.94	10.07	9.43	9.33

Eva.

Solids,	16.38	16.60	15.97	16.04	15.79	16.44	16.28	16.70
Fat,	5.45	6.00	5.17	4.84	5.54	4.77	6.39	6.46
Solids not fat,	10.93	10.60	10.80	11 20	10.25	11.67	9.89	10.24

Lizzie.

Solids,	13.39	13.77	13.20	13.27	14.02	12.89	13 35	13.76
Fat,	3.68	4.46	3.15	3 21	4.32	2.87	4.71	4.61
Solids not fat,	9.71	9.31	10.05	10.06	9.70	10.02	8.64	9.15

Daisy.

Solids,	13.34	11.96	12 63	13.22	12.94	12.95	12.09	12.43
Fat,	4.23	3.09	2.73	3.55	3.54	3.18	3.86	3.78
Solids not fat,	9.11	8.87	9.90	9.67	9.40	9.77	8.23	8.65

Corn Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	-	-	
Dry matter,	86.92	1,738.40	-	-	
	100.00	2,000.00	-	-	
Analysis of dry matter.					
Crude ash,	1.66	33.20	-	-	1 : 9.66
" cellulose,	3.49	69.80	23.73	34	
" fat,	4.97	99.40	75.54	76	
" protein (nitrogenous matter),	10.39	207.80	176.63	85	
Non-nitrogenous extract matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41	-	

Corn and Cob Meal (Average).

	Per cent.
Moisture at 100° C.,	13.69
Dry matter,	86.31
	100.00
Analysis of dry matter.	
Crude ash,	1.68
" cellulose,	7.75
" fat,	3.67
" protein (nitrogenous matter),	9.13
Non-nitrogenous extract matter,	77.77
	100.00

Nutritive ratio, 8.8.

WHEAT BRAN (AVERAGE).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.14	222.80	–	–	1 : 3.85
Dry matter,	88.86	1,777.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	6.59	131.80	–	–	
" cellulose,	12.80	256.00	51.20	20	
" fat,	6.00	120.00	96.00	80	
" protein (nitrogenous matter),	17.72	354.40	311.87	88	
Non-nitrogenous extract matter,	56.89	1,137.80	910.24	80	
	100.00	2,000.00	1,369.31	–	

GLUTEN MEAL (AVERAGE).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.77	195.40	–	–	1 : 2.11
Dry matter,	90.23	1,804.60	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	.93	18.60	–	–	
" cellulose,	4.60	92.00	31.28	34	
" fat,	6.63	132.60	100.78	76	
" protein (nitrogenous matter),	35.43	708.60	602.31	85	
Non-nitrogenous extract matter,	52.41	1,048.20	985.31	94	
	100.00	2,000.00	1,719.68	–	

Hay.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.78	215.60	-	-	1 : 10.52
Dry matter,	89.22	1,784.40	-	-	
	100.00	2,000.00	-	-	
Analysis of dry matter.					
Crude ash,	7.11	142.20	-	-	
" cellulose,	35.55	711.00	412 38	58	
" fat,	2.63	52.60	24.20	46	
" protein (nitrogenous matter),	8.75	175.00	99.75	57	
Non-nitrogenous extract matter,	45.96	919.20	579.10	63	
	100.00	2,000.00	1,115.43	-	

Fodder Corn (dry).

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	24 87	497.40	-	-	1 : 10.31
Dry matter,	75 13	1,502.60	-	-	
	100.00	2,000.00	-	-	
Analysis of dry matter.					
Crude ash,	5.14	102.80	-	-	
" cellulose,	22.26	445.20	320 60	72	
" fat,	2.62	52 40	39.30	75	
" protein (nitrogenous matter),	8.28	165.60	120.89	73	
Non-nitrogenous extract matter,	61.70	1,234.00	826.78	67	
	100.00	2,000.00	1,307.57	-	

Corn Ensilage.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	77.24	1,544.80	–	–	
Dry matter,	22.76	455.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	4.94	98.80	–	–	
" cellulose,	20.66	413.20	297.50	72	1 : 8.8
" fat,	3.15	63.00	47.25	75	
" protein (nitrogenous matter),	9.67	193.40	141.19	73	
Non-nitrogenous extract matter,	61.58	1,231 60	825.17	67	
	100.00	2,000.00	1,311.11	–	

Corn Stover.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	19.07	381.40	–	–	
Dry matter,	80.93	1,618.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	4 22	84.40	–	–	
" cellulose,	20.93	418.60	301.39	72	1 : 9.3
" fat,	2.63	52.60	39.45	75	
" protein (nitrogenous matter),	9.17	183.40	133.88	73	
Non-nitrogenous extract matter,	63.05	1,261.00	844.87	67	
	100.00	2,000.00	1,319.59	–	

II. Feeding Experiments with Milch Cows: Green Crops v. English Hay.

The preceding annual report contains a record of feeding experiments with milch cows, in which some noted green crops were used in place of English hay.

1887. — A mixed crop of green oats and vetch, of Southern cow-pea and of serradella, served in that connection.

Five cows were engaged in the trial. Two cows were fed with a daily fodder ration consisting of corn meal, 3¼ pounds (2 quarts); wheat bran, 3¼ pounds (4 quarts); English hay, 20 to 25 pounds.

The excess of hay left over was weighed back, and subsequently deducted from the original quantity. Three cows received periodically the above-stated daily rations and alternately the following: corn meal, 3¼ pounds; wheat bran, 3¼ pounds; English hay, 5 pounds; and as much of either green vetch and oats, green Southern cow-pea or green serradella, as the individual animal would consume. They consumed per day, on an average, from 64 to 65 pounds of green vetch and oats; of green Southern cow-peas, 96 to 97 pounds; and in case of green serradella, from 97 to 98 pounds. The feeding of the green crop commenced in every instance with the beginning of the blooming period.

The feeding of the different green fodders, in place of three-fourths of the customary daily rations of English hay, gave, on the whole, very satisfactory results. For details, we have to refer to the Fifth Annual Report of the Station.

1888. — The experiment has been repeated with some modifications during the past season. A mixed crop of vetch and oats and one of Southern cow-pea were raised for that purpose. (See record of field C. in this report.)

The quantity of green fodder fed at stated times is somewhat less in pounds than in last year's trial, on account of the addition of gluten meal to our last year's fodder ration.

The daily green fodder ration consisted of corn meal, 3¼ pounds; wheat barn, 3¼ pounds; gluten meal, 3¼ pounds; English hay, 5 pounds; and as much of vetch and oats or cow-pea as the animal would consume, which amounted in

the case of green vetch and oats to from 54 to 68 pounds, and in that of green Southern cow-peas from 70 to 80 pounds.

The nutritive ratio of the green fodder diet was a closer one than on former occasions, varying from 1 : 4.5 to 1 : 5.5. The nutritive effect was very satisfactory, for the animals, without exception, maintained their original weight; the yield of milk was in every instance somewhat raised, and the quality of the milk was equal to the best, as far as one and the same animal was concerned.

Five cows, grades, were turned to account in the trial. The net cost of the feed for the production of one quart of milk was in most instances lower than in case of a whole English hay ration.

The cost of green fodder is based on that of hay, $15.00 per ton, allowing two tons of hay, with fifteen per cent. of moisture, as the average produce of English hay per acre.

This mode of valuation has been adopted, as on previous occasions, on account of the entire absence of market prices, as far as green vetch, cow-pea and serradella are concerned. These crops, as a rule, rank higher in the scale of an agricultural valuation than the meadow grass.

Valuation per Ton of the Articles of Fodder used.

Corn meal,	$24 00	English hay,	$15 00
Corn and cob meal,	20 70	Vetch and oats,	2 75
Wheat bran,	22 50	Cow-pea,	3 14
Gluten meal,	22 50	Rowen,	15 00

The following pages contain the details of the experiment: —

FEEDING RECORD.

MAY: *Age, 7 years; Grade, Jersey; Last Calf, June 6, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.08	2.39	1 : 6.12	905
July 10 to July 22,	3.25	–	3 25	3.25	5.00	62 42	–	–	29.12	11.65	2.50	1 : 5.51	890
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.57	–	–	–	29.10	10.64	2.73	1 : 6.11	893
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	21.63	28.36	11.83	2.40	1 : 5.00	925
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	79.43	–	28.63	12.59	2.27	1 : 4.50	903
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	19.43	–	–	–	25.97	11.25	2.31	1 : 6.09	916

MINNIE: *Age, 8 years; Grade, Ayrshire; Last Calf, May 3, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.42	2.32	1 : 6.12	1,012
July 10 to July 22,	3.25	–	3.25	3.25	5.00	54.39	–	–	27.23	10.92	2.49	1 : 5.43	1,005
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.25	–	–	–	25.81	10.46	2.47	1 : 6.08	1,008
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	20.66	27.47	10.48	2.62	1 : 4.97	1,028
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	79.16	–	28.57	10.78	2.65	1 : 4 50	1,001
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	18.86	–	–	–	25.46	8.82	2.89	1 : 6.05	1,007

FEEDING RECORD — *Continued.*

Melia: *Age, 10 years; Grade, Dutch; Last Calf, Aug. 5, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.79	2.24	1 : 6.12	1,016
July 10 to July 22,	3.25	–	3.25	3.25	5.00	64.33	–	–	29 81	11.62	2.57	1 : 5.53	1,044
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.11	–	–	–	25.69	10.71	2.40	1 : 6.07	1,029
Aug. 11 to Aug. 25,	3.25	–	3.25	3 25	–	–	–	21.27	28.05	11.43	2.45	1 : 4 99	1,055
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	75.34	–	27.83	11.59	2.40	1 : 4.50	1,035
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	17.11	–	–	–	23.90	10.39	2.30	1 : 5.90	1,035

Annie: *Age, 5 years; Grade, Jersey; Last Calf, June 19, 1888.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	16.67	1 59	1 : 6.12	766
July 10 to July 22,	3.25	–	3.25	3.25	5.00	53.48	–	–	26.99	16.38	1.65	1 : 5.42	773
July 26 to Aug. 1,	3.25	–	3.25	3.25	16.43	–	–	–	23.30	14.36	1.71	1 : 5.84	764
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	19.67	26.67	14.70	1 81	1 : 4.94	763
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	71.00	–	26.98	15.13	1.78	1 : 4.50	774
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	17.18	–	–	–	23.97	12.64	1.90	1 : 5.91	768

FEEDING RECORD — *Concluded.*

DAISY: *Age, 5 years; Grade, Durham; Last Calf, Jan. 5, 1888.*

Feeding Periods.	Feed Consumed (pounds) per Day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6, . . .	–	3.25	3.25	3.25	20.00	–	–	–	26.45	14.25	1.86	1 : 6.12	1,084
July 10 to July 22, . . .	3.25	–	3.25	3.25	5.00	67.71	–	–	30.69	14.31	2.14	1 : 5.56	1,127
July 26 to Aug. 1, . . .	3.25	–	3.25	3.25	19.89	–	–	–	26.38	13.36	1.97	1 : 6.13	1,106
Aug. 11 to Aug. 25, . . .	3.25	–	3.25	3.25	–	–	–	21.87	28.57	13.68	2.08	1 : 5.01	1,113
Sept. 7 to Sept. 14, . . .	3.25	–	3.25	3.25	5.00	–	80.00	–	28.74	13.88	2.07	1 : 4.50	1,105
Sept. 19 to Sept. 25, . . .	3.25	–	3.25	3.25	21.00	–	–	–	27.37	9.82	2.79	1 : 6.22	1,084

Total Cost of Feed per Quart of Milk.

May.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6, . . .	66.5	11.08	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.34
July 10 to July 22, . . .	151.1	11.65	42.25	–	42.25	42.25	65.00	811.50	–	–	3 07	2.03
July 26 to Aug. 1, . . .	74.5	10.64	22.75	–	22.75	22.75	137.00	–	–	–	1 82	2.45
Aug. 11 to Aug. 25, . . .	177.5	11.83	48.75	–	48.75	48·75	–	–	–	324.50	4 13	2.33
Sept. 7 to Sept. 14, . . .	100.8	12.59	26.00	–	26 00	26.00	40.00	–	635.75	–	2 20	2.18
Sept. 19 to Sept. 25, . . .	78.8	11.25	22.75	–	22.75	22.75	136.00	–	–	–	1 81	2.30

Minnie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.												
July 1 to July 6, . . .	68.50	11.42	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.27
July 10 to July 22, . . .	142.00	10.92	42.25	–	42 25	42.25	65.00	707.00	–	–	2 93	2.08
July 26 to Aug. 1, . . .	73.25	10.16	22.75	–	22.75	22 75	134.75	–	–	–	1 80	2.46
Aug. 11 to Aug. 25, . . .	157.25	10.48	48.75	–	48.75	48.75	–	–	–	310.00	.4 02	2.56
Sept. 7 to Sept. 14, . . .	86.25	10.78	26.00	–	26.00	26.00	40.00	–	633.25	–	2 20	2.55
Sept. 19 to Sept. 25, . . .	61.75	8.82	22.75	–	22.75	22.75	132.00	–	–	–	1 78	2.88

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Melia.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6,	70.75	11.79	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.20
July 10 to July 22,	151.00	11.62	42.25	–	42.25	42.25	65.00	836.25	–	–	3 11	2.05
July 26 to Aug. 1,	75.00	10.71	22.75	–	22.75	22.75	133.75	–	–	–	1 79	2.39
Aug. 11 to Aug. 25,	171.50	11.43	48.75	–	48.75	48.75	–	–	–	319.00	4 09	2.38
Sept. 7 to Sept. 14,	92.75	11.59	26.00	–	26.00	26.00	40.00	–	602.75	–	2 15	2.32
Sept. 19 to Sept. 25,	72.75	10.39	22.75	–	22.75	22.75	119.75	–	–	–	1 69	2.32

Annie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.												
July 1 to July 6,	100.00	16.67	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	1.56
July 10 to July 22,	213.00	16.38	42.25	–	42.25	42.25	65.00	695.25	–	–	2 91	1.37
July 26 to Aug. 1,	100.50	14.36	22.75	–	22.75	22.75	115.00	–	–	–	1 65	1.64
Aug. 11 to Aug. 25,	220.50	14.70	48.75	–	48.75	48.75	–	–	–	295.00	3 91	1.77
Sept. 7 to Sept. 14,	121.00	15.13	26.00	–	26.00	26.00	40.00	–	568.00	–	2 10	1.44
Sept. 19 to Sept. 25,	88.50	12.64	22.75	–	22.75	22.74	120.25	–	–	–	1 69	1.91

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Daisy.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6, . . .	85.50	14.25	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	1.82
July 10 to July 22, . . .	186.00	14.31	42.25	–	42.25	42.25	65.00	880.25	–	–	3 17	1.65
July 26 to Aug. 1, . . .	93.50	13.36	22.75	–	22.75	22.75	139.25	–	–	–	1 83	1.96
Aug. 11 to Aug. 25, . . .	205.25	13.68	48.75	–	48.75	48.75	–	–	–	328.00	4 15	2.02
Sept. 7 to Sept. 14, . . .	111.00	13.88	26.00	–	26.00	26.00	40.00	–	640.00	–	2 21	1.99
Sept. 19 to Sept. 25, . . .	68.75	9.82	22.75	–	22.75	22.75	147.00	–	–	–	1 89	2.75

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.
[Per Cent.]

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen,
Moisture, ...	12.78	13.69	10.87	10.59	10.78	74.02		8.84
Nitrogen, ...	1.635	1.45	2.415	5.30	1.25	.447		1.93
Phosphoric acid, . .	.746	.688	2.88	4.41	.464	.176	.09	.364
Potassium oxide, . .	.436	.518	1.64	.551	2.085	1.475	.239	2.86
Valuation per 2,000 lbs.,	$6 67	$6 09	$12 82	$18 49	$6 45	$2 94	$2 15	$9 24

Manurial Value of Feed.

Annie.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.					Cents.	Lbs.
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	.95	770
July 10 to July 22,	2 91	2 03	1 62	1 29	.61	768
July 26 to Aug. 1,	1 65	0 80	0 64	1 01	1.00	763
Aug. 11 to Aug. 25,	3 91	2 29	1 83	2 08	.94	777
Sept. 7 to Sept. 14,	2 10	1 24	0 99	1 11	.92	766
Sept. 19 to Sept. 25,	1 69	0 82	0 66	1 03	1 16	781
Total, . . .	$13 82	$7 94	$6 35	$7 47	–	–

Daisy.

1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.11	1,095
July 10 to July 22,	3 17	2 31	1 85	1 33	.71	1,125
July 26 to Aug. 1,	1 83	0 88	0 70	1 13	1.21	1,108
Aug. 11 to Aug. 25,	4 15	2 41	1 95	2 20	1.07	1,112
Sept. 7 to Sept. 14,	2 21	1 31	1 05	1 16	1.05	1,090
Sept. 19 to Sept. 25,	1 89	0 91	0 73	1 16	1.69	1,100
Total, . . .	$14 81	$8 61	$6 89	$7 92	–	–

MANURIAL VALUE OF FEED — *Concluded.*

May.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.					Cents.	Lbs.
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.43	895
July 10 to July 22,	3 07	2 20	1 76	1 31	0.86	880
July 26 to Aug. 1,	1 82	0 88	0 70	1 12	1.50	896
Aug. 11 to Aug 25,	4 13	2 43	1 94	2 19	1.23	916
Sept. 7 to Sept. 14,	2 20	1 30	1 04	1 16	1.15	902
Sept. 19 to Sept. 25,	1 81	0 87	0 70	1 11	1.40	931
Total, . . .	$14 59	$8 44	$6 75	$7 84	–	–

Minnie.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.39	1,010
July 10 to July 22,	2 93	2 05	1 64	1 29	.91	990
July 26 to Aug. 1,	1 80	0 86	0 69	1 11	1.52	1,007
Aug. 11 to Aug. 25,	4 02	2 36	1 89	2 13	1.35	1,022
Sept. 7 to Sept. 14,	2 20	1 30	1 04	1 16	1.34	992
Sept. 19 to Sept. 25,	1 78	0 85	0 68	1 10	1.78	1,035
Total, . . .	$14 29	$8 18	$6 55	$7 74	–	–

Melia.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.34	1,019
July 10 to July 22,	3 11	2 24	1 79	1 32	.87	1,048
July 26 to Aug. 1,	1 79	0 86	0 69	1 10	1.47	1,032
Aug. 11 to Aug. 25,	4 09	2 40	1 92	2 17	1.27	1,045
Sept. 7 to Sept. 14,	2 15	1 27	1 01	1 14	1.23	1,028
Sept. 19 to Sept. 25,	1 69	0 81	0 65	1 04	1.43	1,052
Total, . . .	$14 39	$8 34	$6 67	$7 72	–	–

Analyses of Milk.

[Per Cent.]

May.

	July 3.	July 17.	July 24.	Aug. 7.	Aug. 21.	Sept. 4.	Sept. 15.	Sept. 25.
Water, . .	86.91	85.95	85.72	85.88	86.60	86.12	85.85	85.95
Solids, . .	13.09	14.05	14 28	14.12	13.40	13.88	14.15	14.05
Fat (in solids),	2.44	2.85	4.04	4.40	4.28	3.79	4.54	4.29

Minnie.

Water, . .	86.95	86.48	85 37	85.63	87.10	86.64	86.03	86.00
Solids, . .	13.05	13.52	14.63	14.37	12.90	13.36	13.97	14.00
Fat (in solids),	2.57	3.22	4.08	4.83	4.11	3.91	4.65	4.66

Melia.

Water, . .	86.90	86.63	86.92	86.94	87.73	86 82	87.56	85.98
Solids, . .	13 10	13.37	13.08	13.06	12.27	13.18	12.44	14.02
Fat (in solids),	3.73	3.42	3.61	3.65	3.42	3.37	3.04	4.30

Annie.

Water, . .	88 71	88.51	88.15	87.73	88.51	88.86	87.47	87.22
Solids, . .	11.29	11.49	11.85	12.27	11.49	11.14	12.53	12.78
Fat (in solids),	2.08	1.72	2.99	3.60	3.25	2.30	3.29	3.87

Daisy.

Water, . .	86.39	–	86.84	87.46	87.76	87.39	87.49	85.77
Solids, . .	13.61	–	13.16	12.54	12.24	12.61	12.51	14.23
Fat (in solids),	2.66	–	4.08	3.50	3.54	3.46	3.46	3.98

Corn Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.78	255.60	–	–	
Dry matter,	87.22	1,744.40	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	1.58	31.60	–	–	
" cellulose,	1.69	33.80	11.49	34	1 : 8.95
" fat,	3.96	79.20	60.19	76	
" protein (nitrogenous matter),	11.15	223.00	189.55	85	
Non-nitrogenous extract matter,	81.62	1,632.40	1,534.46	94	
	100.00	2,000.00	1,795.69	–	

The analyses of corn and cob meal and of English hay are the same as used in the preceding experiment.

Wheat Bran (Average Analysis).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.87	217.40	–	–	
Dry matter,	89.13	1,782.60	–	–	
	100.00	2,000,00			
Analysis of dry matter.					
Crude ash,	7.35	147.00	–	–	
" cellulose,	10.38	207.60	41.52	20	1 : 4.05
" fat,	5.11	102.20	81.76	80	
" protein (nitrogenous matter),	16.96	339.20	298.50	88	
Non-nitrogenous extract matter,	60.20	1,2[illegible]4.00	963.20	80	
	100.00	2,000.00	1,384.98	–	

Gluten Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10 59	211.80	–	–	
Dry matter,	89.41	1,788.20	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	.53	10.60	–	–	
" cellulose,	.89	17.80	6.05	34	1 : 2.01
" fat,	5.49	109.80	83.45	76	
" protein (nitrogenous matter),	37.04	740.80	629.68	85	
Non-nitrogenous extract matter,	56.05	1,121.00	1,053.74	94	
	100.00	2,000.00	1,772.92	–	

Vetch and Oats.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	74.02	1,480.40	–	–	–
Dry matter,	25.98	519.60	–	–	–
	100.00	2,000.00	–	–	–
Analysis of dry matter.					
Crude ash,	7.39	147.80	–	–	–
" cellulose,	35.81	716.20	–	–	–
" fat,	2.29	45.80	–	–	–
" protein (nitrogenous matter),	10.76	215.20	–	–	–
Non-nitrogenous extract matter,	43.75	875 00	–	–	–
	100.00	2,000.00	–	–	–

Cow-Pea.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	80.45	1,609.00	–	–	1 : 4.44
Dry matter,	19.55	391.00	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	7.44	148.80	–	–	
" cellulose,	25.88	517.60	243.27	47	
" fat,	2.62	52.40	30.92	59	
" protein (nitrogenous matter),	17.93	358.60	215 16	60	
Non-nitrogenous extract matter,	46.13	922.60	636.59	69	
	100.00	2,000.00	1,125.94	–	

Rowen.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.84	176.80	–	–	1 : 6.4
Dry matter,	91.16	1,823.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	10 50	210.00	–	–	
" cellulose,	29.46	589.20	341.74	58	
" fat,	3.05	61.00	28.06	46	
" protein (nitrogenous matter),	13.20	264.00	150.48	57	
Non-nitrogenous extract matter,	43.79	875 80	551.75	63	
	100.00	2,000.00	1,072.03	–	

EXPERIMENT STATION FARM.

Milk and Creamery Record from Nov. 1, 1887, to Oct. 31, 1888.

	Quarts of Milk produced.	Spaces of Cream from Milk.	Price allowed per Space.	Amount received from Creamery.
1887.				
Nov. 1 to Nov. 30, .	1,692½	756	3.75 cents.	$28 35
Dec. 1 to Dec. 31, .	1,667	872	3.875 "	33 79
1888.				
Jan. 1 to Jan. 31, .	1,979¼	1,105	4.00 "	44 20
Feb. 1 to Feb. 29, .	2,108¾	1,067	4.00 "	42 68
March 1 to March 31, .	1,965	1,013	3.90 "	39 50
April 1 to April 30, .	1,864¼	951	3.65 "	34 71
May 1 to May 31, .	1,798¾	941	3.50 "	32 94
June 1 to June 30, .	1,701½	848	3.25 "	27 56
July 1 to July 31, .	1,966½	920	3.25 "	29 90
Aug. 1 to Aug. 31, .	1,858	894	3.50 "	31 29
Sept. 1 to Sept. 30, .	1,730¼	822	3.75 "	30 82
Oct. 1 to Oct. 31, .	1,759½	897	3.85 "	34 53
Total, ...	22,091¼	11,086	–	$410 27

1887.

Nov., 6.62 spaces of cream make 1 pound of butter, equal to 24.85 cents per pound.

Dec., 6.69 spaces of cream make 1 pound of butter, equal to 25.94 cents per pound.

1888.

Jan., 6.63 spaces of cream make 1 pound of butter, equal to 25.54 cents per pound.

Feb., 6.60 spaces of cream make 1 pound of butter, equal to 26.40 cents per pound.

March, 6.60 spaces of cream make 1 pound of butter, equal to 25 74 cents per pound.

April, 6.65 spaces of cream make 1 pound of butter, equal to 24.27 cents per pound.

May, 6.46 spaces of cream make 1 pound of butter, equal to 22.58 cents per pound.

June, 6.35 spaces of cream make 1 pound of butter, equal to 20.63 cents per pound.

July, 6.45 spaces of cream make 1 pound of butter, equal to 20.96 cents per pound.

Aug., 6.34 spaces of cream make 1 pound of butter, equal to 22.19 cents per pound.

Sept., 6.45 spaces of cream make 1 pound of butter, equal to 24 32 cents per pound.

Oct., 6.39 spaces of cream make 1 pound of butter, equal to 24 61 cents per pound.

III. Feeding Experiments with Pigs: Skim Milk, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

Our annual report for 1887 contains a description of seven successive feeding experiments with growing pigs, which were instituted mainly for the purpose of ascertaining the cost of the feed required for the production of a definite weight of dressed pork.

In the first and second cases, creamery buttermilk and home-made skim milk with corn meal had furnished the sole ingredients of the daily diet of the animals on trial; whilst, during the five succeeding ones, wheat bran and gluten meal had been added as fodder constituents. (For details, see Fifth Annual Report, pages 55 to 83.)

In comparing the final results of the different experiments from a financial stand-point, adopting in all cases, for obvious reasons, a corresponding local market value of the fodder articles used, it was found that feeding skim milk or creamery buttermilk and corn meal in connection with wheat bran and gluten meal, as described in the Fifth Annual Report, experiments III., IV., V., VI., VII., had lessened the net cost of production of dressed pork.

This reduction appeared, however, to be due in the majority of experiments (III., IV., V. and VI.,) rather to a higher commercial value of the manurial refuse resulting, than to a higher nutritive effect of the stated change in the character of the diet. The results obtained in the seventh experiment alone furnished an exception to this circumstance; for, in this case, the smallest quantity of the total weight of the dry feed consumed showed not only a high commercial value of the manurial refuse resulting, but also the highest nutritive effect. The subsequent reprinted summary of the seven experiments may serve as a further illustration of the previous discussion.

SUMMARY OF EXPERIMENTS.

[Based on the same cost of feed and manurial valuation of feed consumed.]

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (in lbs.).	Cost of Feed per pound of Dressed Pork (in cents).	Manurial Value of Feed per pound of Dressed Pork (in cents).	Net Cost of Feed per pound of Dressed Pork after deducting thirty per cent. from Manurial Value (in cents).
II.,	3.31	5.51	2.30	3.90
III., IV., V.,	3.86	5.92	2.91	3.88
VI.,	3.56	5.69	2.78	3.74
VII.,	3.07	5.15	2.52	3.39

From the above summary it is apparent that the course of feeding adopted in the seventh experiment has given the most satisfactory pecuniary results; for the net cost of feed consumed amounted to 3.39 cents per pound of dressed pork produced, after allowing a loss of thirty per cent. of the manurial value of the feed, in consequence of the growth of the animal. As we sold our dressed pork for from $5\frac{1}{2}$ to $7\frac{1}{2}$ cents per pound, we received from 1.5 to 3.5 cents for labor, housing, etc.

The statement that an addition of gluten meal or of wheat bran or of both, to a diet which previously consisted only of skim milk and corn meal, tends to increase the commercial value of the manurial refuse resulting, is based on the following considerations: —

First. The principal fertilizing elements contained in a mixture of equal parts of gluten meal and wheat bran have a higher market value than those contained in an equal weight of corn meal.

Second. It is admissible, for mere practical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, a corresponding amount of nitrogen, of phosphoric acid, of potash, etc., will be retained and stored up in the growing animal.

An excess, therefore, of any or of all of the three essential fertilizing constituents previously specified, in one diet, as compared with that of another one, counts in favor of that

particular diet, as far as net cost of feed is concerned. Although it must be acknowledged that, even in one and the same feeding experiment, most likely no two animals would show strictly corresponding relations in that direction, it remains not less true that it is a most commendable practice, in a general farm management, to consider carefully the relative value of the fertilizing constituents contained in the various fodder articles which present themselves for our choice in the compounding of suitable fodder rations. Our allowance of a loss of thirty per cent. of the essential fertilizing constituents contained in the food consumed, in consequence of the development and growth of the animal, is purposely a liberal one. The adoption of this basis for our estimate tends to strengthen our conclusion that the raising of pigs for the home market can be made a profitable branch of farm industry, even with comparatively limited resources.

It has been stated that, during our III., IV., V., VI. and VII. experiments, the same fodder articles, skim milk, corn meal, wheat bran and gluten meal, had been used to compound the daily diet; and that the seventh feeding experiment had yielded the highest profits on the same basis of selling price. As the daily fodder rations thus in all of these trials had consisted of the same kind of fodder ingredients, and as at all periods of the experiments the call for food had been attended to with care, it became evident that the particular mode of combining at different times the same fodder ingredients to make up the daily diet had to be considered the principal cause of the difference in our results.

To test the correctness of this conclusion it was decided to constitute a new experiment. The same mode of compounding the daily fodder ration for different periods of growth, which had been adopted during the seventh experiment, was to be carried out with a new lot of pigs. (See experiments VIII. and IX. further on.)

The following short abstract, taken from a more detailed description of the seventh feeding experiment in our last annual report, cannot fail to assist in a desirable understanding of the question involved: —

Seven animals, crosses between White Chester and Black Berkshire, served in this experiment (VII.). Their live

weights were from twenty-two to twenty-six pounds in case of different animals. The same fodder articles were used as in the third, fourth, fifth and sixth experiments; they were, however, fed in different proportions. The daily ration of corn meal was gradually increased during the progress of the experiment, for the purpose of altering the relative proportion between the nitrogenous and non-nitrogenous matter in the feed. The relative proportion of one part of digestible nitrogenous matter to two and nine-tenths parts of digestible non-nitrogenous matter was changed at stated periods until it reached 1 : 4.28; practically, three feeding periods.

AVERAGE OF DAILY RATIONS (EXPERIMENT VII.).

	Corn Meal (Ounces).	Skim Milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Feeding Periods.	Nutritive Ratio of Food.
June 28 to July 11,	8.00	4	-	-	I.	1:2.91
July 12 to July 25,	12.00	6	-	-		
July 26 to July 28,	12.00	6	1.34	2.66	II.	1:2.85
July 29 to Aug. 8,	12.00	6	2.00	4.00		
Aug. 9 to Aug. 15,	14.67	6	2.66	2.66	III.	1:3.34
Aug. 16 to Aug. 23,	17.34	6	5.33	5.33		
Aug. 24 to Aug. 29,	20.00	6	8.00	8.00		
Aug. 30 to Sept. 12,	23.34	6	11.35	11.35		
Sept. 13 to Sept. 26,	29.00	6	17.00	17.00		
Sept. 27 to Oct. 11,	47.00	6	12.00	12.00	IV.	1:4.28
Oct. 12 to Oct. 27.	62.66	6	15.66	15.66		

Summary of Experiment VII.

Mark of Pig.	Corn Meal (in lbs.).	Skim Milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during Experiment (in lbs.).	Dressed Weight gained during Experiment (in lbs.).	Cost per pound of Dressed Pork (cents).
N, ...	202.93	176.0	60.04	61.66	163.75	129.36	5.39
O, ...	203.09	176.0	60.21	61.83	161.00	127.19	5.49
P, ...	203.00	176.0	60.21	61.83	174.00	139.20	5.02
Q, ...	194.09	173.0	57.71	59.93	164.50	128.31	5.27
R, ...	194.43	173.0	58.04	59.66	177.50	138.45	4.89
S, ...	194.43	173.0	58.04	59.66	162.50	128.38	5.26
T, ...	194.43	173.0	58.04	59.66	178.25	140.85	4.80
	1,386.40	1,220.0	412.29	424.23	1,181.50	931.74	–

Total Cost of Feed consumed during the Above-stated Experiment (1887).

1,386.40 lbs. corn meal, at $24.00 per ton, ...	$16 64
1,220.00 gals. skim milk, at 1.8 cents per gallon, ...	21 96
412.29 lbs. wheat bran, at $22.50 per ton, ...	4 64
424.23 lbs. gluten meal, at $22.50 per ton, ...	5 77
	$48 01

Average cost of feed for production of one pound of dressed pork, 5.15 cents.

Manurial Value of Feed consumed during the Above Experiment.

Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.	Total.
$5 52	$11 32	$2 97	$3 71	$23 52

Manurial value of feed for production of one pound of dressed pork, 2.52 cents.

The cost of feed consumed varied, in case of different animals, from 4.80 to 5.49 cents per pound of dressed pork produced.

Taking the entire lot of animals into consideration, it amounts to 5.15 cents per pound of dressed pork obtained. The amount of dry matter contained in the feed required for the production of one pound of dressed pork varied from 2.83 to 3.24 pounds.

Basis of Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used (1887).

	Per Cent.			
	Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.
Moisture,	10.00	90.00	10.80	8.80
Nitrogen (17 cents per lb.),	1.96	0.55	2.80	5.03
Phosphoric acid (6 cents per lb.),	0.77	0.17	2.36	0.30
Potassium oxide (4¼ cents per lb.),	0.45	0.20	1.36	0.03
Valuation per 2,000 lbs.,	$7.97	$2.25	$13.51	$17.49

Eighth Feeding Experiment.

Six animals of a mixed breed, weighing from twenty-three to twenty-nine pounds, served in the experiment. The latter began Nov. 8, 1887, and lasted until March 12, 1888, or 124 days; the average of the individual live weight had reached 185 pounds. Skim milk, corn meal or corn and cob meal, wheat bran and gluten meal, furnished the fodder ingredients of the daily diet. The corn and cob meal took the place of the clear corn meal on the 8th of January. The daily ration of skim milk reached, within the first week, six quarts per head. This amount, being the limit of our home supply, was fed daily until the close of the experiment. Skim milk and corn meal, two ounces of the latter to one quart of the former, constituted the diet for about three weeks, when the steadily increasing demand for food was supplied by a gradually increasing quantity of a mixture consisting of two weight parts of gluten meal and one weight part of wheat bran. On the 3d of January, at the beginning of the third month, the daily diet was changed; the latter consisted thereafter of six quarts of skim milk and a mixture prepared of four weight parts of corn and cob meal, one weight part of wheat bran, and one weight part of gluten meal. The quantity required of the latter to meet the daily wants of the animals began with forty-eight ounces per head, and rose gradually to seventy-two ounces. (See, for details, subsequent tabular statement.)

AVERAGE OF DAILY RATIONS (EXPERIMENT VIII.).

	Corn Meal (ounces).	Skim Milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).	Corn and Cob Meal (ounces).	Feeding Periods.	Nutritive Ratio of Food.
1887.							
Nov. 8 to Nov. 15,	10	5	-	-	-	I.	1:2.92
Nov. 16 to Nov. 29,	12	6	-	-	-		
Nov. 30 to Dec. 13,	12	6	2.38	4.76	-	II.	1:2.30
Dec. 14 to Dec. 20,	12	6	5.35	11.06	-		
1888.							
Dec. 21 to Jan. 3,	12	6	9.43	18.86	-		
Jan. 4 to Jan. 7,	32	6	8.00	8.00	-	III.	1:3.80
Jan. 8 to Jan. 16,	-	6	8.87	8.87	35.48		
Jan. 17 to Jan. 30,	-	6	9.81	9.81	39.24		
Jan. 31 to Feb. 20,	-	6	8.00	8.00	48.00	IV.	1:4.17
Feb. 21 to March 11,	-	6	8.81	8.81	52.86		

The entire experiment was managed, as far as practicable, to serve as a repetition of our seventh feeding experiment. The substitution of the corn and cob meal of our own production from a superior home-raised corn, for the clear corn meal of our general market, may well be considered of but little consequence. This view is fully supported by a careful analysis of both.

The financial results of the eighth experiment, like those of the seventh, are superior to those obtained in the preceding five feeding experiments. This fact becomes still more worthy of notice when considering that the seventh experiment was carried on during a warmer period of the year, and thus under more favorable circumstances than the eighth experiment. Our late results seem to confirm the conclusions arrived at in our previous experiments, namely: —

First. A gradual periodical change, from a rich nitrogenous diet to that of a wider ratio between the digestible nitrogenous and non-nitrogenous food constituents of the feed, is recommendable in the interest of good economy.

Second. The feeding effect of one and the same diet changes with the advancing growth of the animal on trial.

Third. The power of assimilating food and of converting it into live weight decreases with the progress in age.

Fourth. It is not good economy to raise pigs for the meat market to an exceptionally high weight. To go beyond from 175 to 180 pounds is only advisable when exceptionally high market prices for dressed pork can be secured.

In addition to what has been said on this particular point in previous communications, I insert here, in a tabular form, the estimated cost of feed used for the production of one pound of live weight during the succeeding stages of growth of the entire lot of pigs which served in the eighth experiment.

Cost of Feed for the Production of One Pound of Live Weight during the Different Feeding Periods.

	Live weight of animals at close of feeding period (in lbs.).	Gain in live weight during period (in lbs.).	One hundred lbs. of dry matter in feed produced live weight (in lbs.).	Cost of feed for production of one lb. of live weight (in cts.).
U. I. Feeding period,	48.50	22.50	63.4	3.24
II. " "	96.50	48.00	51 2	3.58
III. " "	134.00	37.50	33.2	4.80
IV. " "	189 00	55.00	27.3	5.40
V. I. Feeding period,	43.00	20.00	56.3	3.65
II. " "	91.00	48.00	51.2	3.58
III. " "	132.00	41.00	35 8	4.44
IV. " "	198 00	66.00	32 8	4 50
W. I. Feeding period,	44.00	21 50	60.5	3.40
II. " "	96.00	52.00	55.5	3.31
III. " "	130.00	34.00	30.1	5.29
IV. " "	187.00	57.00	28 3	5.21
X. I. Feeding period,	46.00	21 00	59.1	3.48
II. " "	93.00	47.00	50 1	3.66
III. " "	128 00	35.00	30.6	5.20
IV. " "	178.50	50.50	25.0	5.88
Y. I. Feeding period,	46.00	21.00	59.1	3.48
II. " "	93.50	47.50	50.7	3.62
III. " "	133.00	39.50	34.5	4.61
IV. " "	181.50	48.50	23.8	6.12
Z. I. Feeding period,	52.00	22.50	63.4	3.24
II. " "	97.00	45.00	48.0	3.82
III. " "	132.50	35.50	31.1	5.13
IV. " "	184.50	52.00	25.8	5.71

[U.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1 : 2.92	26.00	48.50	1 1
Nov. 30 to Jan. 3,	210 00	25.88	12 41	24 83	-	1 : 2 30	48.50	96 50	1 6
Jan. 4 to Jan. 30,	162 00	9.00	16.00	16.00	55.00	1 : 3.80	96.50	134 00	1 5
Jan. 31 to Mar. 12,	246 00	-	21.27	21.27	127.59	1 : 4 17	134 00	189.00	1 5

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133 38 lbs.
50.26 lbs corn meal, equal to dry matter,	43.69 "
49.68 lbs. wheat bran, equal to dry matter,	44.15 "
62.10 lbs. gluten meal, equal to dry matter,	56.03 "
182.59 lbs. corn and cob meal, equal to dry matter,	157.59 "
Total amount of dry matter,	434.84 lbs.

Live weight of animal at beginning of experiment,	26.00 lbs.
Live weight at time of killing,	189.00 "
Live weight gained during experiment,	163.00 "
Dressed weight at time of killing,	154 00 "
Loss in weight by dressing,	35 lbs., or 18.52 per cent.
Dressed weight gained during experiment,	132.82 lbs

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50 26 lbs. corn meal, at $23.00 per ton,	.58
49.68 lbs. wheat bran, at $23.00 per ton,	.57
62.10 lbs. gluten meal, at $27.00 per ton,	.84
182.59 lbs. corn and cob meal, at $20.70 per ton,	1.90
	$7.22

2.69 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.28 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.44 cents.

PERIOD I.	Cost of feed consumed during period,	$0.73
	22.50 lbs. live weight gained; cost per lb.,	3.24 cts.
	18.33 lbs. dressed weight gained; cost per lb.,	3.98 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	48.00 lbs. live weight gained; cost per lb.,	3.58 cts.
	39.11 lbs. dressed weight gained; cost per lb.,	4.40 cts.
PERIOD III.	Cost of feed consumed during period,	$1.80
	37.50 lbs. live weight gained; cost per lb.,	4.80 cts.
	30.55 lbs. dressed weight gained; cost per lb.,	5.89 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	55.00 lbs. live weight gained; cost per lb.,	5.40 cts.
	44.81 lbs. dressed weight gained; cost per lb.,	6.63 cts.

[V.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1 : 2.92	23.00	43.00	0 15
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1 : 2.30	43.00	91.00	1 6
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1 : 3.80	91.00	132.00	1 7
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1 : 4.17	132.00	198.00	1 10

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49.85 lbs. wheat bran, equal to dry matter,	44.30 "
62.27 lbs. gluten meal, equal to dry matter,	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter,	158.18 "
Total amount of dry matter,	435.74 lbs.

Live weight at beginning of experiment,	23.00 lbs.
Live weight at time of killing,	198.00 "
Live weight gained during experiment,	175.00 "
Dressed weight at time of killing,	160.00 "
Loss in weight by dressing,	38 lbs., or 19.19 per cent.
Dressed weight gained during experiment,	141.41 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal at $23.00 per ton,	.58
49.85 lbs. wheat bran, at $23.00 per ton,	.57
62.27 lbs. gluten meal, at $27.00 per ton,	.84
183.27 lbs. corn and cob meal, at $20.70 per ton,	1.91
	$7.23

2.49 lbs. dry matter yielded 1 lb. of live weight, and 3.08 lbs. dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. dressed pork, 5.11 cents.

PERIOD I.	Cost of feed consumed during period,	$0.73
	20.00 lbs. live weight gained; cost per lb.,	3.65 cts.
	16 16 lbs. dressed weight gained; cost per lb.,	4.52 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	48.00 lbs. live weight gained; cost per lb.,	3.58 cts.
	38.79 lbs. dressed weight gained; cost per lb.,	4.43 cts.
PERIOD III.	Cost of feed consumed during period,	$1.82
	41.00 lbs. live weight gained; cost per lb.,	4.44 cts.
	33.13 lbs. dressed weight gained; cost per lb.,	5.49 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	66.00 lbs. live weight gained; cost per lb.,	4.50 cts.
	53.33 lbs. dressed weight gained; cost per lb.,	5.57 cts.

[W.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1:2 92	22.50	44 00	1 0
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1:2.30	44 00	96.00	1 8
Jan. 4 to Jan. 30,	162 00	9.00	16.00	16.00	55.00	1:3 80	96 00	130 00	1 2
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1:4.17	130.00	187.00	1 6

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49.68 lbs. wheat bran, equal to dry matter,	44.15 "
62.10 lbs. gluten meal, equal to dry matter,	56.03 "
182.59 lbs. corn and cob meal, equal to dry matter,	157.59 "
Total amount of dry matter,	434.84 lbs.

Live weight of animal at beginning of experiment, . .	22.50 lbs.
Live weight at time of killing, ...	187.00 "
Live weight gained during experiment, ...	164.50 "
Dressed weight at time of killing, ...	151.00 "
Loss in weight by dressing, ...	36 lbs., or 19.25 per cent.
Dressed weight gained during experiment, ...	132.83 "

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ...	$3.33
50.26 lbs. corn meal, at $23.00 per ton, ...	.58
49.68 lbs. wheat bran, at $23.00 per ton, ...	.57
62.10 lbs. gluten meal at $27.00 per ton, ...	.84
182.59 lbs. corn and cob meal at $20.70 per ton, ...	1.90
	$7.22

2.64 lbs. dry matter yielded 1 lb. live weight, and 3.27 lbs. dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. dressed pork, 5.44 cents.

PERIOD I.	Cost of feed consumed during period, . . .	$0.73
	21.50 lbs. live weight gained; cost per lb., . .	3.40 cts.
	17.36 lbs. dressed weight gained; cost per lb., .	4.20 cts.
PERIOD II.	Cost of feed consumed during period, . . .	$1.72
	52.00 lbs. live weight gained; cost per lb., . .	3.31 cts.
	41.99 lbs. dressed weight gained; cost per lb., .	4.10 cts.
PERIOD III.	Cost of feed consumed during period, . . .	$1.80
	34.00 lbs. live weight gained; cost per lb., . .	5.29 cts.
	27.45 lbs dressed weight gained; cost per lb., .	6.56 cts.
PERIOD IV.	Cost of feed consumed during period, . . .	$2.97
	57.00 lbs. live weight gained; cost per lb., . .	5.21 cts.
	46.03 lbs. dressed weight gained; cost per lb., .	6.45 cts.

[X.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov 29,	123.00	15.38	-	-	-	1:2.92	25.00	46.00	0 15
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	-	1:2.30	46.00	93.00	1 5
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1:3.81	93.00	128.00	1 3
Jan. 31 to Mar 12,	246.00	-	21.27	21.27	127.59	1:4.17	128.00	178.50	1 3

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50 26 lbs. corn meal, equal to dry matter,	43.69 "
49.85 lbs. wheat bran, equal to dry matter,	44.30 "
62.27 lbs. gluten meal. equal to dry matter,	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter,	158.18 "
	435.74 lbs.

Live weight of animal at beginning of experiment,	25.00 lbs.
Live weight at time of killing,	178.50 "
Live weight gained during experiment,	153.50 "
Dressed weight at time of killing,	160.00 "
Loss in weight by dressing,	18.50 lbs., or 10.38 per cent.
Dressed weight gained during experiment,	137.59 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal, at $23.00 a ton,	.58
49.85 lbs. wheat bran, at $23.00 per ton,	.57
62.27 lbs. gluten meal, at $27.00 per ton,	.84
183.27 lbs. corn and cob meal, at $20.70 per ton,	1.91
	$7.23

2.84 lbs. of dry matter yielded 1 lb. of live weight, and 3.17 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.33 cts.

Period I.	Cost of feed consumed during period,	$0.73
	21.00 lbs. live weight gained; cost per lb.,	3.48 cts.
	18.82 lbs. dressed weight gained; cost per lb.,	3.88 cts.
Period II.	Cost of feed consumed during period,	$1.72
	47.00 lbs live weight gained; cost per lb.,	3.66 cts.
	42.12 lbs. dressed weight gained; cost per lb.,	4.08 cts.
Period III.	Cost of feed consumed during period,	$1.82
	35.00 lbs. live weight gained; cost per lb.,	5.20 cts.
	31.37 lbs. dressed weight gained; cost per lb.,	5.80 cts.
Period IV.	Cost of feed consumed during period,	$2 97
	50.50 lbs. live weight gained; cost per lb.,	5.88 cts.
	45.26 lbs. dressed weight gained; cost per lb.,	6.56 cts.

[Y.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1:2.92	25.00	46.00	0 15
Nov. 30 to Jan. 3,	210.00	25 88	12.41	24.83	-	1:2.30	46.00	93.50	1 5
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1:3.81	93.50	133.00	1 6
Jan. 31 to Mar. 12,	246.00	-	21.27	21.27	127.59	1:4.17	133.00	181.50	1 2

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ... 133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ... 43.69 "
49.85 lbs. wheat bran, equal to dry matter, ... 44.30 "
62.27 lbs. gluten meal, equal to dry matter, . . . 56.19 "
183.27 lbs. corn and cob meal, equal to dry matter, . . 158.18 "

Total amount of dry matter, ... 435.74 lbs.

Live weight of animal at beginning of experiment, . . 25.00 lbs.
Live weight at time of killing, ... 181 50 "
Live weight gained during experiment, ... 156.50 "
Dressed weight at time of killing, ... 150.00 "
Loss in weight by dressing, ... 31.00 lbs., or 17.08 per cent.
Dressed weight gained during experiment, . . . 129.27 lbs

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ... $3 33
50.26 lbs. corn meal at $23.00 per ton, ...58
49.85 lbs. wheat bran, at $23.00 per ton, ...57
62.27 lbs. gluten meal at $27.00 per ton, ...84
183.27 lbs. corn and cob meal, at $20.70 per ton, ... 1.91

$7.23

2.78 lbs. of dry matter yielded 1 lb. of live weight, and 3 37 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.59 cents.

PERIOD I.	Cost of feed consumed during period, . .	$0.73
	21.00 lbs. live weight gained; cost per lb., .	3.48 cts.
	17.83 lbs. dressed weight gained; cost per lb., .	4.09 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	47.50 lbs. live weight gained; cost per lb., .	3.62 cts.
	39.39 lbs. dressed weight gained; cost per lb., .	4.37 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.82
	39.50 lbs. live weight gained; cost per lb., .	4.61 cts.
	32.75 lbs. dressed weight gained; cost per lb., .	5.56 cts
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	48.50 lbs. live weight gained; cost per lb., . .	6.12 cts.
	40.22 lbs. dressed weight gained; cost per lb., .	7.38 cts.

[Z.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1:2.92	29.50	52.00	1 0
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	-	1:2.30	52.00	97.00	1 5
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1:3.81	97.00	132.50	1 4
Jan. 31 to Mar. 12,	246.00	-	21.27	21.27	127.59	1:4.17	132.50	184.50	1 4

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ...	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ...	43.69 "
49.85 lbs. wheat bran, equal to dry matter, ...	44.30 "
62.27 lbs. gluten meal, equal to dry matter, ...	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter, . .	158.18 "
Total amount of dry matter, ...	435.74 lbs.

Live weight of animal at beginning of experiment, . .	29.50 lbs
Live weight at time of killing, ...	184.50 "
Live weight gained during experiment, ...	155.00 "
Dressed weight at time of killing, ...	150.00 "
Loss in weight by dressing, ...	34.50 lbs., or 18.70 per cent.
Dressed weight gained during experiment, ...	126.02 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal, at $23.00 per ton,	.58
49.85 lbs. wheat bran, at $23.00 per ton,	.57
62.27 lbs. gluten meal, at $27.00 per ton,	.84
183.27 lbs. corn and cob meal, at $20.70 per ton,	1.91
	$7.23

2.81 lbs. of dry matter yielded 1 lb. live weight, and 3.46 lbs. of dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.74 cts.

PERIOD I.	Cost of food consumed during period,	$0.73
	22.50 lbs. live weight gained; cost per lb.,	3.24 cts.
	18.29 lbs. dressed weight gained; cost per lb.,	3.99 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	45.00 lbs. live weight gained; cost per lb.,	3.82 cts.
	36.58 lbs. dressed weight gained; cost per lb.,	4.70 cts.
PERIOD III.	Cost of feed consumed during period,	$1.82
	35.50 lbs. live weight gained; cost per lb.,	5.13 cts.
	28.86 lbs. dressed weight gained; cost per lb.,	6.31 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	52.00 lbs. live weight gained; cost per lb.,	5.71 cts.
	42.28 lbs. dressed weight gained; cost per lb.,	7.02 cts.

SUMMARY OF EXPERIMENT VIII.

	Corn Meal (in lbs.).	Skim Milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Corn and Cob Meal (in lbs.).	Live weight gained during experiment (in lbs.).	Dressed weight gained during experiment (in lbs.).	Cost per lb. of Dressed Pork (cts.).
U,	50.26	185 25	49.68	62.10	182.59	163.00	132 82	5.44
V,	50.26	185.25	49.85	62.27	183.27	175.00	141.41	5.11
W,	50.26	185.25	49.68	62.10	182.59	164.50	132.83	5.44
X,	50.26	185.25	49.85	62.27	183.27	153.50	137.59	5.33
Y,	50 26	185.25	49 85	62.27	183.27	156.50	129.27	5.59
Z,	50.26	185.25	49.85	62.27	183.27	155.00	126.02	5.74
Total,	301.56	1,111.50	298.76	373.28	1,098.26	967.50	799.94	–

Total Cost of Feed consumed during Experiment.

1111.50 gals. skim milk, at 1.8 cents per gallon,	$20.01
301.56 lbs. corn meal, at $23.00 per ton,	3.47
298.76 lbs. wheat bran, at $23.00 per ton,	3.44
373.28 lbs. gluten meal at $27.00 per ton,	5.04
1098.26 lbs. corn and cob meal, at $20.70 per ton,	11.42
	$43.38

Average cost of feed for production of 1 lb. dressed pork, 5.42 cts.

Manurial Value of Feed consumed during Experiment.

Skim milk,	$8.85
Corn meal,	1.09
Wheat bran,	1.99
Gluten meal,	2.88
Corn and cob meal,	3.33
	$18.14

Manurial value of feed for production of 1 lb. of dressed pork, 2.27 cts.

Basis of Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used (1888).

	Per Cent.				
	Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.	Corn and Cob Meal.
Moisture,	13.08	91.00	11.14	9.77	13.69
Nitrogen ($16\frac{1}{2}$ cents per lb.),	1.80	.47	2.78	4 57	1.45
Phosphoric acid (6 cents per lb),	.74	.22	1.86	.30	.69
Potassium oxide ($4\frac{1}{4}$ cents per lb.),	.43	.21	1.07	.03	.55
Valuation per 2,000 lbs.,	$7.20	$1.99	$12.35	$15.46	$6.06

The net cost of feed consumed for the production of one pound of dressed pork, making a deduction of thirty per cent. of the fertilizing constituents contained in the feed, varies in the case of different animals from 3.52 cents to 4.00 cents per pound. In the case of the entire lot of pigs, it amounts to 3.83 cents per pound. As we sold our dressed pork at $7\frac{3}{4}$ cents per pound, we secured 3.92 cents per pound sold for investment, labor and profit.

It will be noticed that our estimates above are based on the ruling local market prices of the time when our late experiments were carried on. These prices differ from those adopted on earlier occasions. An intelligent comparison of our late financial results with those obtained in previous experiments can only be made by using corresponding values. The subsequent page contains a re-valuation of our late results, on the basis of market value used in all previous feeding experiments.

Summary of Experiment based on the Same Cost of Feed and of Manurial Value of Feed consumed as used in Preceding Experiments.

Total Cost of Feed consumed during Experiment.

1111.50 gals. skim milk, at 1.8 cents per gallon,	$20.01
301.56 lbs. corn meal, at $24.00 per ton,	3.62
298.76 lbs. wheat bran, at $22.50 per ton,	3.36
373.28 lbs. gluten meal, at $22.50 per ton,	4.20
1098.26 lbs. corn and cob meal, at $20.70 per ton,	11.42
	$42.61

Average cost of feed for production of 1 lb. dressed pork, 5.32 cts.

Manurial Value of Feed consumed during Experiment.

Skim milk,	$10.00
Corn meal,	1.20
Wheat bran,	2.02
Gluten meal,	3.26
Corn and cob meal,	3.33
	$19.81

Manurial value of feed for production of 1 lb. dressed pork, 2.48 cts.

The net cost of feed for the production of one pound of dressed pork, taking the entire lot of pigs into consideration, amounts to 3.69 cents. This result is the second best in our whole series of experiments. This fact becomes more significant when it is duly considered that the experiment (VIII.) was carried out during the winter season. The task of maintaining a desirable moderate temperature in the piggery during the entire trial becomes more difficult in winter than during any other season of the year. Low temperature requires more food for the support of respiration; the normal condition of the animal system is apt to be more seriously affected in various directions, and the gain in live weight suffers usually correspondingly in case of the same diet.

To confirm, if possible, our previously advanced conclusions still more, it was decided to repeat our mode of feeding with another lot of pigs during the latter part of spring and the summer season. An examination of our ninth experiment, which is described in a few subsequent pages, cannot fail to show that they are fully sustained.

Analyses of Fodder Articles used in Experiment VIII.

SKIM MILK (AVERAGE).

	Per Cent.
Moisture at 100° C.,	91.00
Dry matter,	9.00
	100.00

Analysis of Dry Matter.

Crude ash,	6.67
" fat,	2.78
" protein (nitrogenous matter),	34.00
Non-nitrogenous extract matter,	56.55
	100.00

Nutritive ratio, 1 : 1.86.

CORN MEAL (AVERAGE).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	–	–	1 : 9.66
Dry matter,	86.92	1,738.40	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	1.66	33.20	–	–	
" cellulose,	3.49	69.80	23.73	34	
" fat,	4.97	99.40	75.54	76	
" protein (nitrogenous matter),	10.39	207.80	176.63	85	
Non-nitrogenous extract matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41		

WHEAT BRAN (AVERAGE).

	Percentage composition.	Constituents (In lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.14	222.80	–	–	1 : 3.85
Dry matter,	88.86	1,777.20	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	6.59	131.80	–	–	
" cellulose,	12.80	256.00	51.20	20	
" fat,	6.00	120.00	96.00	80	
" protein (nitrogenous matter),	17.72	354.40	311.87	88	
Non-nitrogenous extract matter,	56.89	1,137.80	910.24	80	
	100.00	2,000.00	1,369.31	–	

GLUTEN MEAL (AVERAGE).

	Percentage composition.	Constituents (In lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.77	195.40	–	–	1 : 2.11
Dry matter,	90.23	1,804.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	.93	18.60	–	–	
" cellulose,	4.60	92.00	31.28	34	
" fat,	6.63	132.60	100.78	76	
" protein (nitrogenous matter),	35.43	708.60	602.31	85	
Non-nitrogenous extract matter,	52 41	1,048.20	985.31	94	
	100.00	2,000.00	1,719.68	–	

Corn and Cob Meal.

	Per cent.
Moisture at 100° C.,	13.69
Dry matter,	86.31
	100.00

Analysis of Dry Matter.

Crude ash,	1.68
" cellulose,	7.75
" fat,	3.67
" protein (nitrogenous matter),	9.13
Non-nitrogenous extract matter,	77.77
	100.00

Nutritive ratio, 1 : 8.8.

Ninth Experiment.

Six pigs of a mixed breed, weighing from seventeen to twenty-two pounds each, served in the experiment. The feeding began April 12, and closed August 8. The live weights of the animals at the time of killing varied from 185 to 203.5 pounds. Skim milk, corn meal, gluten meal and wheat bran furnished the ingredients of the diet. The mode of feeding was practically divided into three periods, with reference to the nutritive character of the feed, as follows: —

	Live Weight of Animal.	Nutritive Ratio.
I. Period,	20 to 90 lbs.,	1 digestible nitrogenous; 2.66 digestible non-nitrogenous constituents.
II. Period,	90 to 130 lbs.,	1 digestible nitrogenous; 3.62 digestible non-nitrogenous constituents.
III. Period,	130 to 200 lbs.,	1 digestible nitrogenous; 4.35 digestible non-nitrogenous constituents.

AVERAGE OF DAILY RATIONS (EXPERIMENT IX.).

	Corn Meal (ounces).	Skim Milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).	Corn and Cob Meal (ounces).	Feeding Periods.	Nutritive Ratio of Food.
1888.							
April 12 to April 23, . .	-	3	-	-	6.	I.	1 : 2.80
April 24 to May 1, . .	-	6	-	-	12.		
May 2 to May 14, . .	-	6	3.47	6.94	12.	II.	1 : 2.53
May 15 to May 28, . .	-	6	9.89	19.78	12.		
May 29 to June 4, . .	-	6	10.67	21.34	12.		
June 5 to June 22, . .	-	6	8.65	8.65	34.60	III.	1 : 3.63
June 23 to July 3, . .	-	6	9.86	9.86	39.44		
July 4 to July 9, . .	-	6	7.70	7.70	46.20	IV.	1 : 4.35
July 10 to July 25, . .	56.10	6	9.35	9.35	-		
July 26 to Aug. 8, . .	63.00	6	10.50	10.50	-		

[1.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	21.50	50.00	1 7
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	50.00	95.00	1 5
June 5 to July 3,	-	174.00	66.12	16 87	17.99	1 : 3.62	95.00	140.25	1 10
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	140.25	200.75	1 11

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter, ...	95.03 lbs.
675.00 qts. skim milk, equal to dry matter, ...	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter, . .	102.44 "
53.65 lbs. wheat bran, equal to dry matter, ...	46.94 "
70.38 lbs. gluten meal, equal to dry matter, ...	63.28 "
Total amount of dry matter, ...	429.19 lbs.

Live weight of animal at beginning of experiment,	21.50 lbs.
Live weight of animal at time of killing,	200.75 "
Live weight gained during experiment,	179.25 "
Dressed weight at time of killing,	162.00 "
Loss in weight by dressing,	38.75 lbs., or 19.3 per cent.
Dressed weight gained during experiment,	144.65 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
268.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $27.00 per ton,	84
	$6 99

2.40 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.97 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.83 cents.

[2.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	20.00	45.00	1 4
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	45.00	88.00	1 5
June 5 to July 3,	-	174.00	65.09	16.60	16.93	1 : 3.63	88.00	128.25	1 6
July 4 to Aug 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	128.25	185.75	1 95

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
117.66 lbs. corn and cob meal, equal to dry matter,	101.55 "
53.38 lbs. wheat bran, equal to dry matter,	46.71 "
69.32 lbs. gluten meal, equal to dry matter,	62.33 "
Total amount of dry matter,	427.12 lbs.

Live weight of animal at beginning of experiment,	20.00 lbs.
Live weight of animal at time of killing,	185.75 "
Live weight gained during experiment,	165.75 "
Dressed weight at time of killing,	152.00 "
Loss in weight by dressing,	33.75 lbs., or 18.17 per cent
Dressed weight gained during experiment,	135.63 lbs

Cost of Feed consumed during Experiment.

189.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
117.66 lbs. corn and cob meal, at $20.70 per ton,	1 22
53.38 lbs. wheat bran, at $23.00 per ton,	61
69.32 lbs. gluten meal, at $24.00 per ton,	83
	$6 96.

2.58 lbs. dry matter fed yielded 1 lb. of live weight, and 3.17 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 5.13 cents.

[3.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	19.00	44.50	1 4
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	44.50	91.25	1 6
June 5 to July 3,	-	174.00	66.12	16.87	17.99	1 : 3.62	91.25	132.00	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	132.00	196.25	1 11.5

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102.44 "
53.65 lbs. wheat bran, equal to dry matter,	46.94 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	19.00 lbs.
Live weight of animal at time of killing,	196.25 "
Live weight gained during experiment,	177.25 "
Dressed weight at time of killing,	159.00 "
Loss in weight by dressing,	37.25 lbs., or 18.98 per cent.
Dressed weight gained during experiment,	143.61 lbs

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.42 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.00 lbs of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.86 cents.

[4.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	–	83.00	10.38	–	–	1 : 2.80	17.00	42.00	1 4
May 2 to June 4,	–	204 00	25.50	15.60	31.21	1 : 2.53	42.00	85.25	1 4
June 5 to July 3,	–	174.00	66.12	16.87	17.99	1 : 3.62	85.25	126.00	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	126.00	188.75	1 12

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102 44 "
53.65 lbs. wheat bran, equal to dry matter,	46.94 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	17.00 lbs.
Live weight of animal at time of killing,	188.75 "
Live weight gained during experiment,	171.75 "
Dressed weight at time of killing,	154.25 "
Loss in weight by dressing,	34.50 lbs., or 18.27 per cent.
Dressed weight gained during experiment,	140.36 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23 00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.50 lbs. dry matter fed yielded 1 lb. of live weight, and 3.06 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.98 cents.

[5.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1:2.80	21.50	45.00	1 3
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1:2.53	45.00	86.75	1 4
June 5 to July 3,	-	174.00	66.12	16.87	17.99	1:3.62	86.75	129.50	1 7.5
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1:4.35	129.50	193.75	1 12

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102.44 "
53.65 lbs. wheat bran, equal to dry matter,	46.96 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	21.50 lbs.
Live weight of animal at time of killing,	193.75 "
Live weight gained during experiment,	172.25 "
Dressed weight at time of killing,	158.00 "
Loss in weight by dressing,	35.75 lbs., or 18.45 per cent.
Dressed weight gained during experiment,	140.47 lbs

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton, ...	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon, ...	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton, . . .	1 23
53.65 lbs. wheat bran, at $23.00 per ton, ...	62
70.38 lbs. gluten meal, at $24.00 per ton, ...	84
	$6 99

2.49 lbs. of dry matter fed yielded 1 lb. of live weight, and
3.07 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.97 cents.

[6.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.)	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.)	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	18.25	47.00	1 7
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	47.00	95.00	1 7
June 5 to July 3,	-	174.00	66.12	16.87	17.99	1 : 3.62	95.00	142.25	1 10
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	142.25	203.50	1 11

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter, ...	95.03 lbs.
675.00 qts. skim milk, equal to dry matter, ...	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter, . .	102.44 "
53.65 lbs. wheat bran, equal to dry matter, ...	46.94 "
70.38 lbs. gluten meal, equal to dry matter, ...	63.28 "
Total amount of dry matter, ...	429.19 lbs.

Live weight of animal at beginning of experiment, . .	18.25 lbs.
Live weight of animal at time of killing, ...	203.50 "
Live weight gained during experiment, ...	185.25 "
Dressed weight at time of killing, ...	165.50 "
Loss in weight by dressing, ...	35 lbs., or 17.2 per cent.
Dressed weight gained during experiment, ...	153.39 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton, ...	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon, ...	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton, . . .	1 23
53.65 lbs. wheat bran, at $23.00 per ton, ...	62
70.38 lbs. gluten meal, at $24.00 per ton, ...	84
	$6 99

2.32 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.81 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.56 cents.

SUMMARY OF EXPERIMENT IX.

	Corn Meal (in lbs.).	Skim Milk (in gals.).	Corn and Cob Meal (in lbs.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during experiment (in lbs.).	Dressed Weight gained during experiment (in lbs.).	Cost per pound of Dressed Pork (cents).
1, ...	109.97	168.75	118.69	53.65	70.38	179.25	144.65	4.83
2, ...	109.97	168.75	117.66	53.38	69.32	165.75	135.63	5.13
3, ...	109.97	168.75	118.69	53.65	70.38	177.25	143.61	4.86
4, ...	109.97	168.75	118.69	53.65	70.38	171.75	140.36	4.98
5, ...	109.97	168.75	118.69	53.65	70.38	172.25	140.47	4.97
6, ...	109.97	168.75	118.69	53.65	70.38	185.25	153.39	4.56
	659.82	1,012.50	711.11	321.63	421.22	1,051.50	858.11	–

Total Cost of Feed consumed during the Above-stated Experiment.

659.82 lbs. corn meal, at $23.00 per ton, ...	$7 59
1,012.50 gals. skim milk, at 1.8 cents per gallon, . . .	18 23
711.11 lbs. corn and cob meal, at $20.70 per ton, . . .	7 36
321.63 lbs. wheat bran, at $23.00 per ton, ...	3 70
421.22 lbs. gluten meal, at $24.00 per ton, ...	5 05
	$41 93

Average cost of feed for production of 1 lb. of dressed pork, 5.15 cents.

Manurial Value of Feed consumed during the Above Experiment.

Corn Meal.	Skim Milk.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Total.
$2 11	$8 29	$2 16	$2 01	$4 05	$18 62

Manurial value of feed for production of 1 lb. of dressed pork, 2.17 cents.

SUMMARY OF EXPERIMENTS (II. TO IX. INCLUSIVE).

[Based on the same cost of feed and manurial valuation of feed consumed.]

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (in lbs.).	Cost of Feed per pound of Dressed Pork (in cents).	Manurial Value of Feed per pound of Dressed Pork (in cents).	Net Cost of Feed per pound of Dressed Pork after deducting thirty per cent. from Manurial Value (in cents).
II.,	3.31	5.51	2.30	3.90
III., IV., V.,	3.86	5.92	2.91	3.88
VI.,	3.56	5.69	2.78	3.74
VII.,	3.07	5.15	2.52	3.39
VIII.,	3.27	5.32	2.48	3.58
IX.,	3.00	4.89	2.30	3.27

Cost of Feed for the Production of One Pound of Live Weight during the Different Feeding Periods.

	Live Weight of Animal at close of feeding period (in lbs.).	Gain in Live Weight during period (in lbs.).	Cost of Feed for production of one pound of Live Weight (in cents).
1. I. Feeding Period,	50.00	28.50	1.72
II. " "	95.00	45.00	3.87
III. " "	140.25	45 25	4.13
IV. " "	200.75	60.50	4.78
2. I. Feeding Period,	45.00	25.00	1.96
II. " "	88.00	43.00	4.05
III. " "	128.25	40.25	4.57
IV. " "	185 75	57.50	5 03
3. I. Feeding Period,	44.50	25.50	1.92
II. " "	91.25	46.75	3.72
III. " "	132.00	40.75	4.59
IV. " "	196.25	64.25	4.50
4. I. Feeding Period,	42.00	25.00	1.96
II. " "	85.25	43.25	4.02
III. " "	126.00	40.75	4.59
IV. " "	188.75	62.75	4.61
5. I. Feeding Period,	45.00	23.50	2.09
II. " "	86.75	41.75	4.17
III. " "	129.50	42.75	4.38
IV. " "	193.75	64.25	4.50
6. I. Feeding Period,	47.00	28.75	1.70
II. " "	95.00	48.00	3.63
III. " "	142.25	47.25	3.96
IV. " "	203.50	61.25	4.72

Analyses of Fodder Articles used in Experiment IX.

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.59	271.80	–	–	1 : 9.56
Dry matter,	86.41	1,728.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.68	33.60	–	–	
" cellulose,	1.56	31.20	10.61	34	
" fat,	3.10	62.00	47.12	76	
" protein (nitrogenous matter),	10.42	208.40	177.14	85	
Non-nitrogenous extract matter,	83.24	1,664.80	1,564.91	94	
	100.00	2,000.00	1,799.78	–	

The analyses of corn and cob meal and of skim milk are the same as used in the preceding experiment.

WHEAT BRAN.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.50	250.00	–	–	1 : 3.86
Dry matter,	87.50	1,750.00	–	–	
	100.00	2,000.00			
Analysis of Dry Matter.					
Crude ash,	6.80	136.00	–	–	
" cellulose,	10.70	214.00	42.80	20	
" fat,	5.49	109.80	87.84	80	
" protein (nitrogenous matter),	17.79	355.80	313.10	88	
Non-nitrogenous extract matter,	59.22	1,184.40	947.52	80	
	100.00	2,000.00	1,391.26	–	

Gluten Meal.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.09	201.80	–	–	
Dry matter,. . . .	89.91	1,798.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	.51	10.20	–	–	
" cellulose, ...	.86	17.20	5.85	34	1 : 1.82
" fat, ...	4.86	97.20	73.87	76	
" protein (nitrogenous matter), . . .	39.28	785.60	667.76	85	
Non-nitrogenous extract matter, ...	54.49	1,089.80	1,024.41	94	
	100.00	2,000.00	1,771.89	–	

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4¼ cents.

	Per Cent.				
	Corn Meal.	Skim Milk.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.
Moisture, ...	13.59	–	13.69	12.50	10.09
Nitrogen, ...	1.60	.48	1.45	2.49	5.65
Phosphoric acid, ...	.662	.22	.688	2.54	.455
Potassium oxide, ...	.387	.21	.548	1.45	.059
Valuation per 2,000 lbs., . .	$6 40	$2 02	$6 09	$12 50	$19 25

ANALYSES OF FODDER ARTICLES.

CORN FODDER (PRIDE OF THE NORTH).

	Per cent.
Moisture at 100° C.,	24.87
Dry matter,	75.13
	100.00

Analysis of Dry Matter.

Crude ash,	5.14
" cellulose,	22.26
" fat,	2.62
" protein (nitrogenous matter),	8.28
Non-nitrogenous extract matter,	61.70
	100.00

Fertilizing Constituents in Corn Fodder.

Moisture at 100° C.,	24.87
Nitrogen (16½ cts. per lb.),	.995
Phosphoric acid (6 cts. per lb.),	.201
Calcium oxide,	.310
Magnesium oxide,	.093
Potassium oxide (4¼ cts. per lb.),	1.465
Sodium oxide,	.794
Ferric oxide,	.026
Insoluble matter,	1.318
Valuation per 2,000 lbs.,	$4 77
Weight of stalk and ear (average),	8 oz.
" stalk (average),	3 oz.
" ear (average),	5 oz.

The above material was cut when the kernels began to glaze. Part of the crop was put into a silo. Both products have been used of late in our feeding experiments with milch cows.

CORN COB (PRIDE OF THE NORTH).

[Experiment Station, 1887.]

	Per cent.
Moisture at 100° C.,	24.76
Dry matter,	75.24
	100.00

Analysis of Dry Matter.

	Per cent.
Crude ash,	1.75
" cellulose,	33.77
" fat,	.53
" protein (nitrogenous matter),	3.00
Non-nitrogenous extract matter,	60.95
	100.00

Fertilizing Constituents in Corn Cob.

Moisture at 100° C.,	24.76
Nitrogen (16½ cts. per lb.),	.36
Phosphoric acid (6 cts. per lb.),	.069
Calcium oxide,	.005
Magnesium oxide,	.008
Potassium oxide (4¼ cts. per lb.),	.512
Sodium oxide,	.265
Ferric oxide,	.006
Insoluble matter,	.267
Valuation per 2,000 lbs.,	$1 71

CORN AND COB MEAL (PRIDE OF THE NORTH).

[Experiment Station, 1887.]

	PER CENT.	
	I.	II.
Passed sieve, 144 meshes to square inch,	75.36	73 85
Moisture at 100° C.,	26.34	13.69
Dry matter,	73.66	86.31
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.64	1.68
" cellulose,	6.31	7.75
" fat,	3 36	3.67
" protein (nitrogenous matter),	7.82	9.13
Non-nitrogenous extract matter,	80.87	77.77
	100.00	100.00

Fertilizing Constituents in Corn and Cob Meal.

	Per cent.
Moisture at 100° C.,	26.34
Nitrogen (16½ cts. per lb.),	1.24
Phosphoric acid (6 cts. per lb.),	.587
Calcium oxide,	.095
Magnesium oxide,	.131
Potassium oxide (4¼ cts. per lb.),	.468
Sodium oxide,	.200
Ferric oxide,	.004
Insoluble matter,	.130
Valuation per 2,000 lbs.,	$5 19

CORN ENSILAGE.

[Sent on from Marblehead, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	78.88	83.48
Dry matter,	21.12	16.52
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.32	4.30
" cellulose,	25.77	35 25
" fat,	3.27	3.33
" protein (nitrogenous matter),	8.94	6.91
Non-nitrogenous extract matter,	55.70	50.21
	100.00	100.00

Both samples of ensilage, it is stated, were planted and harvested at the same time ; both had their kernels fully developed, just past the milky state, when they were put into a silo, Sept. 20 to 30, 1887. No. I. is from "Stowell's Evergreen Sweet," and No. II. from common "Southern White" corn.

Ensilage No. I. shows a larger percentage of nitrogenous and non-nitrogenous matter than No. II., yet it was of a decidedly inferior general state of preservation when received at our office. Whether this circumstance applies to the entire contents of each silo, or is merely of an accidental nature, we are unable to decide.

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.97	239.40	–	–	1 : 8.41
Dry matter,	88.03	1,760.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.48	29.60	–	–	
" cellulose,	1.83	36.60	12.44	34	
" fat,	4.81	96.20	73.11	76	
" protein (nitrogenous matter),	11.88	237.60	201.96	85	
Non-nitrogenous extract matter,	80.00	1,600.00	1,504.00	94	
	100.00	2,000.00	1,791.51	–	

Wheat Bran.

[Sent on from North Amherst, Mass.]

68.97 per cent. passed screen 144 mesh to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.43	188.60	–	–	1 : 4.00
Dry matter,	90.57	1,811.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.27	125.40	–	–	
" cellulose,	12.98	259.60	51.92	20	
" fat,	4.36	87.20	69.76	80	
" protein (nitrogenous matter),	16.76	335.20	294.98	88	
Non-nitrogenous extract matter,	59.63	1,192.60	954.08	80	
	100.00	2,000.00	1,370.74	–	

The material is of a fair average composition.

Fertilizing Constituents in Wheat Bran.

	Per cent.
Moisture at 100° C.,	9.43
Phosphoric acid (6 cts. per lb.),	2.67
Magnesium oxide,	.83
Calcium oxide,	.18
Potassium oxide (4¼ cts. per lb.),	1.51
Sodium oxide,	.15
Nitrogen (16½ cts. per lb.),	2.43
Insoluble matter,	.24
Valuation per 2,000 lbs.,	$12 50

WHEAT BRAN.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.25	185.00	–	–	1 : 4.26
Dry matter,	90.75	1,815.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.90	158.00	–	–	
" cellulose,	10.05	201.00	40.20	20	
" fat,	4.73	94.60	75.68	80	
" protein (nitrogenous matter),	16.12	322.40	283.71	88	
Non-nitrogenous extract matter,	61.20	1,224.00	979.20	80	
	100.00	2,000.00	1,378.79	–	

Wheat Bran.

[Amherst Mills.]

67.50 per cent. passed screen 144 mesh to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.89	197.80	–	–	1 : 3.57
Dry matter,	90.11	1,802.22	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.26	145.20	–	–	
" cellulose,	14.80	296.00	59.20	20	
" fat,	5.22	104.40	83.52	80	
" protein (nitrogenous matter),	18.17	363.40	319.79	88	
Non-nitrogenous extract matter,	54.55	1,091.00	872.80	80	
	100.00	2,000.00	1,335.31	–	

Gluten Meal.

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.50	190.00	–	–	1 : 1.95
Dry matter,	90.50	1,810.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.08	21.60	–	–	
" cellulose,	4.74	94.80	32.23	34	
" fat,	3.92	78.40	59.58	76	
" protein (nitrogenous matter),	36.19	723.80	615.23	85	
Non-nitrogenous extract matter,	54.07	1,081.40	1,016.52	94	
	100.00	2,000.00	1,723.56	–	

Gluten Meal.

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.10	222.00	–	–	
Dry matter,	88.90	1,778.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.55	11.00	–	–	
" cellulose,	.91	18.20	6.19	34	1 : 2.24
" fat,	6.13	122.60	93.18	76	
" protein (nitrogenous matter),	34.79	695.80	591.43	85	
Non-nitrogenous extract matter,	57.62	1,152.40	1,083.26	94	
	100.00	2,000.00	1,774.06	–	

Rowen.

[Grown at the Experiment Station, 1887. Contained a liberal admixture of clover.]

	Per cent.
Moisture at 100° C.,	8.84
Dry matter,	91.16
	100.00

Analysis of Dry Matter.

Crude ash,	10.50
" cellulose,	29.46
" fat,	3.05
" protein (nitrogenous matter),	13.20
Non-nitrogenous extract matter,	13.79
	100.00

Fertilizing Constituents of the above Rowen.

Moisture at 100° C.,	8.840
Nitrogen (16½ cts. per lb.),	1.930
Phosphoric acid (6 cts. per lb.),	.364
Potassium oxide (4¼ cts. per lb.),	2.860
Calcium oxide,	.853
Magnesium oxide,	.197
Sodium oxide,	.122
Ferric oxide,	.057
Insoluble matter,	2.178
Valuation per 2,000 lbs.,	$9 24

Provender.

[From Amherst Mill.]

	Per cent.
Moisture at 100° C.,	9.40
Dry matter,	90.60
	100.00

Analysis of Dry Matter.

Crude ash,	3.42
" cellulose,	11.52
" fat,	5.76
" protein (nitrogenous matter),	14.35
Non-nitrogenous extract matter,	64.95
	100.00

Nutritive ratio, 1 : 7.56.

This article is, according to statement, a mixture of 450 pounds of corn, 125 pounds of oats, and 100 pounds of wheat bran.

Ground Oat Feed.

[Sent on from Salem, Mass.]

	Per cent.
Moisture at 100° C.,	8.92
Dry matter,	91.08
	100.00

Analysis of Dry Matter.

Crude ash,	3.52
" cellulose,	8.78
" fat,	8.34
" protein (nitrogenous matter),	18.66
Non-nitrogenous extract matter,	60.69
	100.00

The article is evidently a compound containing admixtures which are richer in nitrogenous matter and fat than oats. A mere analysis of a compound commercial fodder article is only of interest to the practical farmer when the amount and kind of ingredients which serve in its preparation are well known. It is not safe, as a rule, to invest to any extent in a compound commercial fodder article without feeling well satisfied concerning the character of its various ingredients.

Spent Brewer's Grain.

72.63 per cent. passed through mesh 144 to square inch.

	Per cent.
Moisture at 100° C.,	6.98
Dry matter,	93.02
	100.00

Analysis of Dry Matter.

Crude ash,	6.15
" cellulose,	15.90
" fat,	1.95
" protein (nitrogenous matter),	20.49
Non-nitrogenous extract matter,	55.51
	100.00

Fertilizing Constituents of Spent Brewer's Grain.

Moisture at 100° C.,	6.98
Nitrogen (16½ cts. per lb.),	3.05
Phosphoric acid (6 cts. per lb.),	1.26
Potassium oxide (4¼ cts. per lb.),	1.552
Calcium oxide,	.296
Magnesium oxide,	.286
Sodium oxide,	.347
Ferric oxide,	.159
Insoluble matter,	1.770
Valuation per 2,000 lbs.,	$12 88

The material is of a fair quality as far as composition is concerned.

Cotton Hulls.

[I. and II. sent on from Boston, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.17	11.45
Dry matter,	89.83	88.85
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	2.75	3.38
" cellulose,	51.40	40.24
" fat,	2.36	4.27
" protein (nitrogenous matter),	4.90	5.36
Non-nitrogenous extract matter,	38.59	46.75
	100.00	100.00

Fertilizing Constituents of Cotton Hulls.

[I. and II. sent on from Boston (same as above); III. sent on from Memphis, Tenn.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	10.17	11.45	8.76
Phosphoric acid,	.14	.28	.18
Magnesium oxide,	.23	.29	.25
Calcium oxide,	.13	.20	.22
Potassium oxide,	1.12	1.06	1.07
Nitrogen,	.77	.76	.74
Insoluble matter,	.06	.003	.11
Valuation per 2,000 lbs.,	$3 66	$3 75	$3 57

COTTON-SEED MEAL.

[Sent on from North Amherst, Mass.]

68.34 per cent. passed sieve 144 mesh to square inch.

	Per cent.
Moisture at 100° C.,	6.84
Dry matter,	93.16
	100.00

Analysis of Dry Matter.

Crude ash,	7.06
" cellulose,	10.83
" fat,	13.02
" protein (nitrogenous matter),	40.13
Non-nitrogenous extract matter,	28.96
	100.00

A fair sample of its kind.

FIELD EXPERIMENTS.

I. Field A. Fodder Corn raised with Single Articles of Plant Food.

II. Field B. Fodder Crops raised with and without Complete Manure.

III. Field C. Experiments with Fodder Crops for Green Fodder.

IV. Experiments with Potatoes; and Paper on Potato Scab, by Prof. James E. Humphrey.

V. Experiments with Root Crops.

VI. Notes on Miscellaneous Field Work.

FIELD EXPERIMENTS.

[Field A.]

I. Fodder Corn raised upon Worn-out Meadow Lands partly fertilized with One or Two Special Articles of Plant Food, partly without the Use of any Manurial Matter.

The observations recorded below extend already over a period of five years.* The field selected for the experiment was utilized for a series of years previous to 1882 as a meadow for the production of hay. The annual yield of that crop had suffered at that time a serious decline in quantity and quality. During the spring of 1883 it was planted with corn for the production of fodder corn, without the use of any manurial matter.

The same course of planting and of general treatment was carried out during the year 1884. The corn fodder raised in that year left no doubt about the serious exhaustion of the soil, as far as its fitness for a further successful cultivation of corn fodder was concerned, for the entire yield of that crop amounted only to 5,040 pounds per acre, with a moisture of thirty per cent. The soil had evidently reached a condition which promised to prove favorable for a special investigation, as far as the extent and the particular character of its exhaustion on plant food was concerned, whether the failure of the crop was due to a general exhaustion of

* For details, see preceding reports, 1883, 1884, 1885, 1886, 1887.

essential articles of plant food, or to that of any particular one of them.

As the cultivation of grasses and fodder corn affects the manurial resources of the soil in a similar direction, by abstracting approximately one part of phosphoric acid to four parts of potash, it seemed but natural that a soil which originally did not contain much more of available potash than of available phosphoric acid must become unproductive, as far as these crops are concerned, before the latter is exhausted. It is not less evident that a system of manuring, devised with reference to this circumstance alone, can prevent an early decline of remunerative crops in the majority of cases.

The recognized importance of both — grasses and fodder corn — in our present system of general farm management has served as the principal inducement to begin our field experiments at the Experiment Station with a practical illustration of the particular serious changes which a close rotation of these crops produces in the existing soil resources of plant food, wherever the adopted system of manuring does not provide for a periodical return of fertilizing substances, with reference to the kind and to the amount of each of them carried off by the crop.

The land set apart for the experiment consists of ten adjoining plats, one-tenth of an acre each in size. The plats are five feet apart; the grounds between them are kept free from any growth, and receive no fertilizing ingredients of any description. The entire field is surrounded by a tile drain, and each plat has a separate one through its centre. This terminates at its east end in a well, which is connected with the surrounding drain.

The systematic treatment of the various plats began in May, 1885. All were ploughed, year after year, at the same time and in the same manner, — in autumn after harvesting and in spring before manuring and planting. Plats 1, 3, 5, 7, 9 and 10 received annually for three succeeding years, 1885, 1886 and 1887, an addition of a definite amount of either phosphoric acid or of a nitrogen compound or of a potash compound; while plats 2, 4, 6 and 8 received no

manurial matter during that period. All, except plat 6, were planted during the above-stated three succeeding years with the same variety of corn (Clark). Plat 6 received during that time no fertilizing material; it was ploughed and worked with the cultivator in the same manner and at the same time when the other plats were thus treated; it was kept clear, as far as practicable, from every kind of vegetable growth (black fallow).

The details of the work and of the annual results of the course pursued in the management of the experiment have been described in the preceding annual report. The subsequent summary may suffice here to record the principal facts brought out before the beginning of the present year (1888).

FIELD "A."

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886 and 1887, planted with "Clark" corn.]

Number of Plat.	Fertilizers Applied.			Yield of Dry Fodder Corn.		
	1885.	1886.	1887.	1885.	1886.	1887.
				Lbs.	Lbs.	Lbs.
Plat 1, .	25 lbs. sodium nitrate (= 4 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	480	430	720
Plat 2, .	Nothing, ...	Nothing, ...	Nothing, ...	310	250	165
*Plat 3, .	30 lbs. dried blood (= 4 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	350	310	240
Plat 4, .	Nothing, ...	Nothing, ...	Nothing, ...	300	250	130
Plat 5, .	25 lbs. ammonium sulphate (= 5 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), ...	360	280	635
Plat 6, .	Fallow, ...	Fallow, ...	Fallow, ...	-	-	-
Plat 7, .	50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), . .	280	255	730
Plat 8, .	Nothing, ...	Nothing, ...	Nothing, ...	250	195	165
Plat 9, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	945	840	655
Plat 10, .	48½ lbs. of potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen), ...	845	895	940

A careful study of these results shows that neither phosphoric acid nor any form of nitrogen, when applied each by itself, even in exceptionally large proportions, has produced a material change in the annual yield, as compared with that obtained on unfertilized plats. The application of potash compounds alone shows in every instance a decided increase in the crop. The annual yield was increased by its use during the first two years to twice the amount of that previous to its special application.

1888.—The original plan of the experiment has not been altered materially during the past season. The principal aim of our investigation has been the same as during the three preceding years; namely, to study the direction and the degree of exhaustion on plant food of field "A" during the progress of our investigation.

The results of the past season (1888) confirm the conclusion presented in our previous annual report, 1887. An exceptional deficiency of the soil on available potash, produced by continued close rotation of grasses and corn fodder, without any substantial provision for an exceptionally large consumption of potash, proves still the first cause of a reduced annual yield of corn fodder.

The exhaustion on available plant food assumes, however, as might be expected, a more general character as years pass on. This fact shows itself plainly in a gradual falling off of the annual yield on plat 9, where a liberal amount of potash as the sole fertilizing material exerted in preceding years a marked beneficial influence on the annual yield. The same circumstance causes evidently the lower yield upon those plats (1 and 7) which received a liberal manuring with potash compounds two years later, and, after a repeated application of each, phosphoric acid or nitrogen had failed to improve the annual yield.

A manuring for three successive years with potash alone has sufficed in our case to terminate its beneficial effect on the natural productiveness of the soil, as far as the corn crop is concerned. More complete manures are required to restore a desirable degree of fertility of the soil.

The result obtained on plat 6 deserves a particular notice. This plat had been used, in common with the entire area

occupied by our experiment, for two years in succession,—1883 and 1884,—for the production of fodder corn without the use of any manurial matter. The degree of exhaustion of the entire field was very marked and practically uniform. During the spring of 1885, when all other plats were planted with the same variety of corn, plat 6 was ploughed and harrowed like the remainder, but not planted with corn; it was assigned to the task of ascertaining the effects of "black fallow" on the soil under treatment. It seemed of interest, in connection with our inquiry, to illustrate the influence of mere atmospheric agencies on the future productiveness of our field. For this purpose, during the years 1885, 1886 and 1887, the plat was ploughed, harrowed and treated with the cultivator in the same manner and at the same time as the remaining plats. During that entire period no manurial matter of any description was applied. The appearance of every description of vegetation was, as far as practicable, prevented by a timely use of the cultivator.

At the beginning of the past season, after having produced no crop for three succeeding years, it was prepared in the same way and at the same time as the other plats for the planting of one and the same variety of corn. No manurial matter was on that occasion applied to plat 6. The date of planting the corn, and the subsequent treatment of the crop to the time of harvesting, was the same in all cases. The yield of fodder corn upon plat 6 was the third lowest in the scale including all plats; *i. e.*, 1,930 pounds per acre. It was also the poorest-looking crop upon field "A" during the larger portion of the season. The result shows, in a very striking manner, that the growing of plants does materially assist in rendering available the inherent mineral plant food of the soil. The growth of three years, although in our case exceptionally small, was lost to us. Our observation in this connection confirms the results of more recent careful investigations into older systems of agricultural practice. Black fallow, as a rule, does not materially benefit the productiveness of an exhausted soil, and ought to be discouraged, therefore, from a mere financial point, at present rates of rent.

The subsequent more detailed description of the field

work carried on during the past season, as well as the conditions of the crop at different stages of growth, upon different plats into which field "A" has been subdivided, will enable all parties interested in the experiment to draw their own conclusions regarding its teachings.

The entire field was ploughed twice, as in previous years,—in autumn, a short time after harvesting the crop, and early in the succeeding spring. The fertilizing materials, single or compound, wherever used, were applied broadcast, and slightly harrowed under some time before planting.

Plat 1. Received 50 pounds of muriate of potash (25 pounds of potassium oxide).

Plat 2. 50 pounds of nitrate of soda (7–8 pounds of nitrogen).

Plat 3. 100 pounds of dissolved bone-black (16–17 pounds of soluble phosphoric acid).

Plat 4. Nothing.

Plat 5. 97 pounds of magnesia sulphate.

Plat 6. Nothing.

Plat 7. 50 pounds of muriate of potash (25 pounds of potassium oxide).

Plat 8. 50 pounds of sulphate of ammonia (10 pounds of nitrogen).

Plat 9. 50 pounds of muriate of potash (25 pounds of potassium oxide.

Plat 10. 97 pounds of sulphate of potash and magnesia (25 pounds of potassium oxide); 100 pounds of dissolved bone-black (16–17 pounds of soluble phosphoric acid).

The corn (Clark) was planted in drills, May 29. The rows were three feet and three inches apart, and the kernels were dropped in the rows from twelve to fourteen inches apart, with six to eight seeds in a place. The entire field was subsequently kept clean from weeds by a frequent use of the cultivator or the hoe, as circumstances advised.

The young plants appeared above ground quite uniformly, June 5. They soon showed, however, marked differences in regard to the rate of growth upon different plats, and presented, as the season advanced, more or less striking differences in their general appearance.

HEIGHT OF CORN ON PLATS, IN INCHES (1888).

	June 27.	July 5.	July 12.	July 20.	July 27.	Aug. 3.	Aug. 10.	Aug. 17.	Aug. 24.
Plat 1, . .	8	8½	12	15	20	27	45	58	72
Plat 2, . .	7	7½	9	11	15	18	29	40	62
Plat 3, . .	7	9	12½	14½	19	22	34	41	45
Plat 4, . .	4½	5½	7	8½	12	14	20	25	35
Plat 5, . .	8	10	13½	17	23	30	45	60	72
Plat 6, . .	5	5½	6	6½	7	9	14	25	32
Plat 7, . .	8	10	15	19	26	36	56	67	74
Plat 8, . .	5	8	8½	10	13	15	19	25	29
Plat 9, . .	7	9	12	15	19	33	36	55	63
Plat 10, . .	9	13	17	20	30	49	72	85	84

A change in the color of the plants was first noticed at the beginning of July upon plat 6, and subsequently in those upon plat 8. Tassels appeared at about the same time on plats 1, 2, 3, 5, 7 and 9, and about three days later on plats 4, 6 and 8. An examination of the plants at the time of cutting, September 14, showed that those raised upon plats 2, 3, 4, 6 and 8 had either no ears or but a few imperfect ones, while those from plats 1, 5, 7 and 9 had more. Plat 10 had from two to three times as many as either of the last mentioned. The majority of the plats, with the exception of plat 10, had produced only small and imperfect ears.

The following tabular statement contains the exact results, as far as the character of the crop is concerned: —

	Height of Plants When Cut.	Weight of Stover.	Weight of Ears.
Plat 1,	72 inches.	559 lbs.	58 lbs.
Plat 2,	62 "	280 "	23 "
Plat 3,	45 "	150 "	0 "
Plat 4,	35 "	113 "	1 "
Plat 5,	72 "	510 "	54 "
Plat 6,	32 "	193 "	0 "
Plat 7,	74 "	626 "	50 "
Plat 8,	29 "	141 "	5 "
Plat 9,	63 "	487 "	66 "
Plat 10,	84 "	607 "	130 "

The experiment will be continued, with some modifications, for another year. As the condition of the soil in field "A" (see next page) becomes from year to year better known, its fitness for investigations of a similar character increases as time advances.

The photographic illustrations accompanying this chapter represent some of the most striking features noticeable in the growth of these plats. They illustrate in particular the striking influence of potash on the annual yield, and show the disadvantages of black fallow on the productiveness of farm lands.

The annual yield of crops of dry corn fodder is stated with reference to the same moisture, 48 per cent.

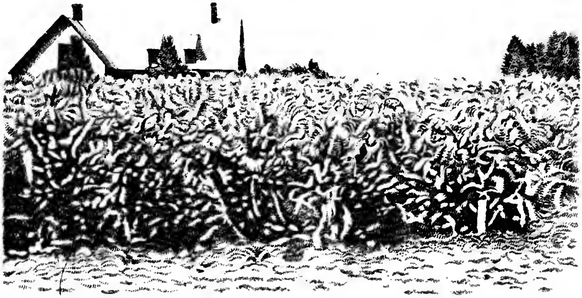
The crops raised during the years 1886, 1887 and 1888, on plats 1, 2, 6, 7 and 9, have served for our illustrations.

FIELD "A."

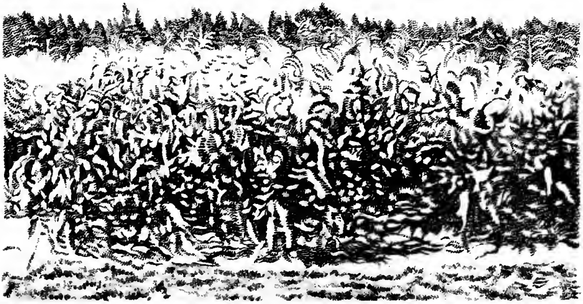
[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886, 1887 and 1888, planted with "Clark" corn.]

Number of Plat.	Fertilizers Applied.		Yield of Dry Fodder Corn.		Yield per Acre.
	1887.	1888.	1887.	1888.	1888.
			Lbs.	Lbs.	Lbs.
Plat 1, . .	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen), and 50 lbs. muriate potash (= 25 lbs. potassium oxide).	50 lbs. muriate potash (= 25 lbs. potassium oxide), ...	720	617	6,170
Plat 2, . .	Nothing, ...	50 lbs. nitrate of soda (= 7 to 8 lbs. nitrogen), .	165	303	3,030
Plat 3, . .	60 lbs. dried blood (= 7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	240	150	1,500
Plat 4, . .	Nothing, ...	Nothing, ...	130	114	1,140
Plat 5, . .	50 lbs. ammonium sulphate (= 10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. sulphate magnesia, ...	635	564	5,640
Plat 6, . .	Fallow, ...	Nothing, ...	-	193	1,930
Plat 7, . .	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	730	676	6,760
Plat 8, . .	Nothing, ...	50 lbs. sulphate of ammonia (= 10 lbs. nitrogen),	165	146	1,460
Plat 9, . .	50 lbs. muriate of potash (= 25 lbs. potassium oxide), .	50 lbs. muriate of potash (= 25 lbs potassium oxide), ...	655	553	5,530
Plat 10, . .	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), .	940	737	7,370

EXPERIMENTS WITH CORN FODDER. FIELD A. PLAT 1.
(One-tenth of an acre.)



1886. 50 lbs. Sodium Nitrate (=7 to 8 lbs. nitrogen).
Yield of Dry Corn Fodder, 430 lbs.



1887. 50 lbs. Sodium Nitrate (=7 to 8 lbs. Nitrogen) and 50 lbs. Muriate of Potash (=25 lbs. potassium oxide).
Yield of Dry Corn Fodder, 720 lbs.

1888. 50 lbs. Muriate of Potash (=25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder, 617 lbs.

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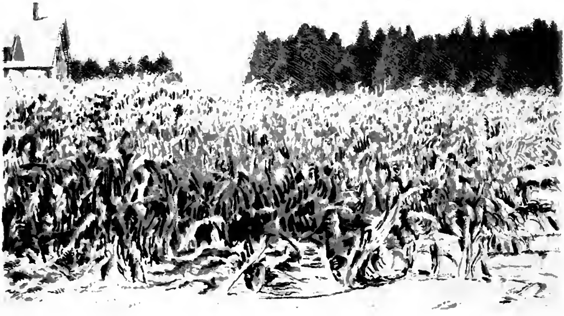
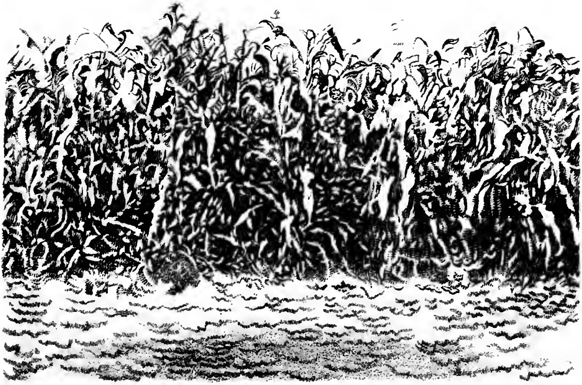
1886. No Fertilizer.
Yield of Dry Corn Fodder, 250 lbs



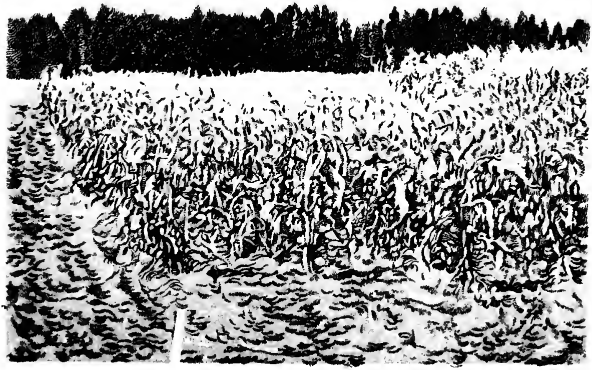
1887 No Fertilizer.
Yield of Dry Corn Fodder, 165 lbs

1888. 50 lbs. Sodium Nitrate (= 7 to 8 lbs Nitrogen).
Yield of Dry Corn Fodder, 303 lbs



A field with complete manure, consisting of Barn-yard manure and potash Salts.

Yield of Dry Corn Fodder, 2800 lbs.



Plat 6. 1888. Was kept free from any vegetation from 1885 to 1888; and planted in 1888 with corn without receiving any manurial matter.

Yield of Dry Corn Fodder, 193 lbs.

WRIGHT & POTTER PRINTING CO., STATE PRINTERS

1886. 100 lbs. Dissolved Bone-black (= 17 lbs. available phosphoric acid). Yield of Dry Corn Fodder, 255 lbs.

1887. 100 lbs. Dissolved Bone-black (= 17 lbs. available phosphoric acid) and 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide). Yield of Dry Corn Fodder, 730 lbs.

1888. 50 lbs. Muriate of Potash (= 25 lbs. of Potassium Oxide). Yield of Dry Corn Fodder, 676 lbs.

1886. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder, 840 lbs.

1887 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide)
Yield of Dry Corn Fodder, 655 lbs.

1888 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder, 553 lbs.

II. Influence of Fertilizers on the Quantity and Quality of Prominent Fodder Crops.

[Field "B."]

The field assigned to the above-stated inquiry is located west of field "A," and has been used, like the latter, for several years previous to the establishment of the Experiment Station, for the production of hay. The land is nearly on a level, and runs from north to south; it occupies at the present time an area of 1.7 acres. The soil consists of a somewhat sandy loam. During the spring of 1883 it was ploughed and prepared for raising corn fodder. This crop was raised for one year in drills, and without the aid of any manurial matter. The previous thorough mechanical treatment of the soil, as well as its impoverished condition, was considered favorable for the contemplated work. In 1884 the entire field was subdivided into eleven plats of equal size, with five feet of space between them. Every alternate plat has received from that date annually the same kind and same amount of fertilizer, — six hundred pounds of ground bones and two hundred pounds of muriate of potash per acre. The fertilizer has been applied at an early date each spring, either broadcast or between the rows, as circumstances admitted. It was in each case subsequently slightly harrowed under. Since 1885, all crops on that field have been raised in rows; this system of cultivation became a necessity in the case of grasses, clovers, etc., to secure a clean crop for observation. The rows, in the case of corn and leguminous plants, were three feet and three inches apart; and in the case of grasses, two feet. The space between the different plats measured five feet; it has received thus far no manurial substance of any description, and is kept clean from vegetation by a proper use of the cultivator. Plats 11, 13, 15, 17, 19 and 21 are fertilized annually; plats 12, 14, 16, 18 and 20 have received thus far no fertilizer. The single plats are either occupied by one variety of plants or by two; in some instances several plats are used for one and the same crop. Corn and various prominent varieties of meadow grasses and of leguminous plants have thus far been selected for observation.

The details of the work carried on upon field "B" are from year to year recorded in the annual report of the Station. As the chemical analyses of the crops raised require considerable time, on account of other contemporary pressing engagements in the laboratory, they are usually published in bulletins and the reports of the succeeding year. These analyses may claim a special interest, as they are made of a variety of fodder crops, raised, as far as practicable, under corresponding circumstances with reference to climate, to soil, to system of manuring, to the adopted modes of cultivation, of harvesting and of analyzing. In making this statement, I do not mean to imply that our local conditions of climate and of soil are in every instance the most favorable ones to enable the various crops here on trial to attain in all cases the highest possible development. This qualification of our results applies with more or less propriety to some varieties of grasses as well as of leguminous plants.

The subsequent tabular record of the crops raised upon the different plats of field "B" since 1884 may assist in a desirable understanding of its past history and its condition at the beginning of the season of 1888. The single plats are, since 1886, each 175 feet long and 33 feet wide.

STATEMENT OF CROPS RAISED ON FIELD "B."

PLATS.	1884.	1885.	1886.	1887.
PLAT 11 (fertilized),	Orchard grass (*Dactylis glomerata*), Meadow fescue (*Festuca pratensis*),	Orchard grass, Meadow fescue,	Orchard grass, Meadow fescue,	Corn.
PLAT 12 (unfertilized),	Orchard grass, Meadow fescue,	Orchard grass, Meadow fescue,	Orchard grass, Meadow fescue,	Corn.
PLAT 13 (fertilized),	Hungarian grass (*Panicum Germanicum*), Pearl millet (*Penicillaria spicata*),	Hungarian grass, Pearl millet,	Hungarian grass, Pearl millet,	Italian rye-grass (*Lolium Italicum*). English rye-grass (*Lolium perenne*).
PLAT 14 (unfertilized),	Hungarian grass, Pearl millet,	Hungarian grass, Pearl millet,	Hungarian grass, Pearl millet,	Italian rye-grass. English rye-grass.
PLAT 15 (fertilized),	Timothy (*Pleum pratense*), Red-top (*Agrostis vulgaris*),	Timothy, Red-top,	Timothy, Red-top,	Five varieties Southern cow-pea.
PLAT 16 (unfertilized),	Timothy, Red-top,	Timothy, Red-top,	Timothy, Red-top,	Five varieties Southern cow-pea.
PLAT 17 (fertilized),	Corn (variety, Clark),	Corn,	Corn,	Meadow fescue.
PLAT 18 (unfertilized),	Corn,	Corn,	Corn,	Alsike clover (*Trifolium hybridum*). Medium red clover (*Trifolium pratense*).
PLAT 19 (fertilized),	Corn,	Corn,	Corn,	Alsike clover. Medium red clover.
PLAT 20 (unfertilized),	Corn,	Corn,	Corn,	Mammoth red clover (*Trifolium medium*). Alfalfa or lucerne (*Medicago sativa*).
PLAT 21 (fertilized),	Corn,	Corn,	Corn,	Mammoth red clover. Alfalfa.

1888. — At the beginning of the season but few changes became necessary in the management of the field; for, plats 13, 14, 17, 18, 19, 20 and 21 being still occupied by a perennial vegetation, only plats 11, 12, 15 and 16 required particular attention in that direction. It was decided to add the Kentucky blue-grass (*Festuca pratensis*) and the Soja bean (*Soja hispida*) to our list of prominent crops on trial upon field "B."

Plats 11 and 12 were seeded down, in drills two feet apart, with Kentucky blue-grass; and plats 15 and 16 with Soja beans, in rows three feet and three inches apart, to correspond with the rule adopted for grasses and leguminous plants. In both instances one plat was fertilized in the same way as heretofore, with fine-ground bones and muriate of potash (11 and 15), and the other two (12 and 16) received no fertilizer. The Kentucky blue-grass was seeded down rather late, May 24, and the Soja beans May 18. The mechanical condition of the soil was in both cases very satisfactory for the work.

Those plats which were still occupied by perennial plants, planted in preceding years, were treated between the rows at an early date with the cultivator, and subsequently the weeds and foreign growth in the rows removed with the hoe and the hand. Plats 13, 17, 19 and 21 received at the same time their annual supply of manure, consisting of fine-ground bones and muriate of potash. Plats 14, 16, 18 and 20 received none.

As the plats were 175 feet long and 33 feet wide, equal to an area of 5,775 square feet, each received a mixture of 80 pounds of ground bones and 27 pounds of muriate of potash.

The subsequent enumeration of crops raised upon field "B," during the years 1887 and 1888, shows the change made in crops at the beginning of the past season.

	1887.	1888.
Plat No. 11 (fertilized), .	Corn (Clark variety).	Kentucky blue-grass.
Plat No. 12 (unfertilized),	Corn (Clark variety).	Kentucky blue-grass.
Plat No. 13 (fertilized), .	Italian rye-grass (*Lolium Italicum*). English rye-grass (*Lolium perenne*).	Italian rye-grass. English rye-grass.
Plat No. 14 (unfertilized),	Italian rye-grass. English rye-grass.	Italian rye-grass. English rye-grass.
Plat No. 15 (fertilized), .	Five varieties Southern cow-pea.	Soja bean.
Plat No. 16 (unfertilized),	Five varieties Southern cow-pea.	Soja bean.
Plat No. 17 (fertilized), .	Meadow fescue (*Festuca pratensis*).	Meadow fescue.
Plat No. 18 (unfertilized),	Alsike clover. Medium red clover.	Alsike clover. Medium red clover.
Plat No. 19 (fertilized), .	Alsike clover. Medium red clover.	Alsike clover. Medium red clover.
Plat No. 20 (unfertilized),	Mammoth red clover. Alfalfa (lucerne).	Mammoth red clover. Alfalfa.
Plat No. 21 (fertilized), .	Mammoth red clover. Alfalfa (lucerne).	Mammoth red clover. Alfalfa.

The general appearance of the plats seeded down in preceding years with perennial varieties of grasses and of leguminous plants presented some interesting features at the opening of the late season. Some crops had suffered seriously from winter-killing, while others had passed unharmed through the winter. Wherever the growth had suffered, the fact showed itself invariably in the most serious degree upon unfertilized plats.

Perennial rye-grass, plat 14 (unfertilized), was almost entirely winter-killed; while upon plat 13 (fertilized) a much less serious effect could be noticed.

Italian rye-grass looked decidedly better preserved in both instances than the perennial rye-grass.

Meadow fescue, plat 17 (fertilized), appeared remarkably vigorous, and retained the lead for the entire season, as far as the varieties of grasses on trial are concerned.

Alsike clover was seriously winter-killed upon the unfertilized plat 18, while upon the fertilized plat 19 it was very well preserved.

Medium red clover appeared in fair condition upon plat 18 (unfertilized), yet fell behind the alsike clover on plat 19 (fertilized).

Alfalfa and *mammoth clover*, on plats 20 and 21, presented the same features in their growth as was noticed with reference to alsike clover and medium clover.

The weight of the hay obtained from the first cut of each kind of crop, when well advanced in blooming, gives a fair representation of their general character and condition at the time of harvesting. The yield is in every instance stated with reference to an entire plat (175×33 feet), in case of fertilized as well as unfertilized ones.

GRASSES.

	English Rye-Grass, cut July 5, 1888.	Italian Rye-Grass, cut July 5, 1888.	Meadow Fescue, cut July 2, 1888.
Fertilized plat, . .	300 lbs.	260 lbs.	700 lbs.
Unfertilized plat, . .	90 "	105 "	No plat.

LEGUMINOUS PLANTS.

	Medium Red Clover, cut July 5, 1888.	Alsike Clover, cut July 5, 1888.	Mammoth Red Clover, cut July 5, 1888.	Alfalfa, cut July 5, 1888.
Fertilized plat, . .	690 lbs.	490 lbs.	460 lbs.	150 lbs.
Unfertilized plat, .	250 "	70 "	20 "	50 "

SOJA BEAN (GREEN).

Cut Aug. 30, 1888.

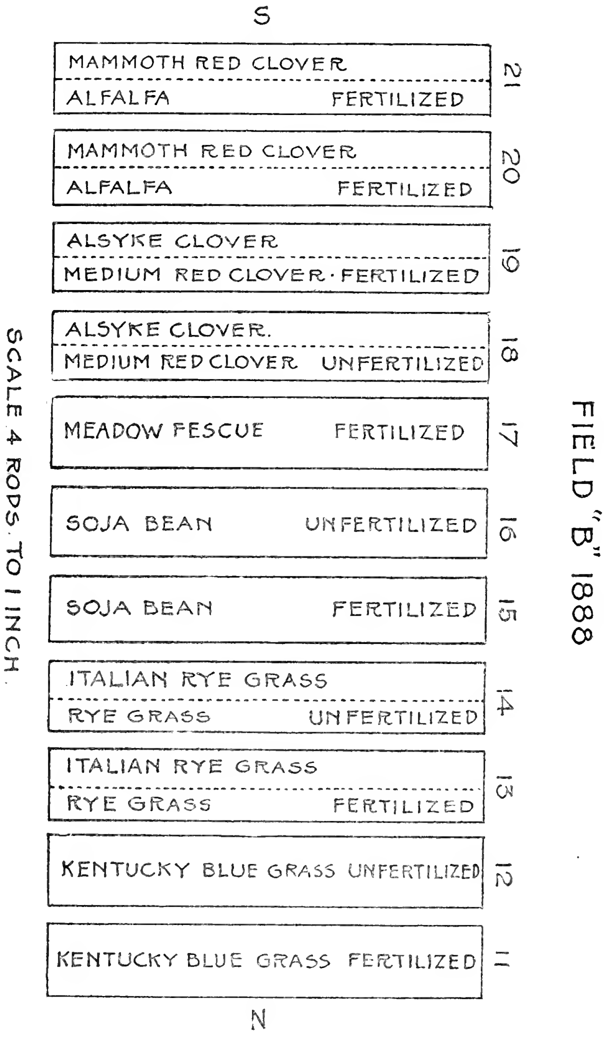
Fertilized plat, ...	2,080 lbs.
Unfertilized plat, ...	1,560 "

(The crop was put into a silo Aug. 30, 1888.)

The Soja bean has been raised during the past season in different parts of the field, to serve for ensilage. The investigation of this valuable plant is not yet finished, and a detailed description has been reserved for a future date.

As the cultivation in rows is an exceptional one as far as meadow grasses and clovers are concerned, no attempt has been made to state their yield per acre. The principal aim of the experiment on field "B" consists, as has been stated above, in securing suitable samples of each crop on trial, for the purpose of ascertaining the influence of stage of growth and of a different degree of fertility of the soil on their composition. Sufficient material has been collected of every crop stated above, and the results of a chemical analysis of each will be published from time to time as the work advances.

The analyses of alfalfa and of alsike clover of the first year's growth (1887) have been already published in the annual report for that year; also analyses of orchard grass, red-top, meadow fescue and timothy. (See pages 125–132.)


S
MAMMOTH RED CLOVER
ALFALFA FERTILIZED
21
MAMMOTH RED CLOVER
ALFALFA FERTILIZED
20
ALSYKE CLOVER
MEDIUM RED CLOVER · FERTILIZED
19
ALSYKE CLOVER.
MEDIUM RED CLOVER UNFERTILIZED
18
MEADOW FESCUE FERTILIZED
17
SOJA BEAN UNFERTILIZED
16
SOJA BEAN FERTILIZED
15
ITALIAN RYE GRASS
RYE GRASS UNFERTILIZED
14
ITALIAN RYE GRASS
RYE GRASS FERTILIZED
13
KENTUCKY BLUE GRASS UNFERTILIZED
12
KENTUCKY BLUE GRASS FERTILIZED
11
N
SCALE 4 RODS. TO 1 INCH.
FIELD "B" 1888

III. Experiments with Fodder Crops for Green Fodder.

[Field "C."]

In a discourse on fodder supply for dairy cows, in the preceding annual report, pages 89, 90, the following statement was made : —

The practice of raising a greater variety of valuable crops for green fodder deserves the serious consideration of farmers engaged in the dairy business ; for it secures a liberal supply of healthy, nutritious fodder, at a time when hay becomes scarce and costly, and when it would be still a wasteful practice to feed an imperfectly matured green fodder corn. The frequently limited area of land fit for a remunerative production of grasses, and the not less recognized exhausted condition of a large proportion of natural pastures, make it but judicious to consider seriously the means which promise not only to increase, but also to cheapen, the products of the dairy.

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, peas, beans, lupines, etc., is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range, for the introduction of economical systems of rotations, under various conditions of soil, and different requirements of markets. Most of these fodder plants have an extensive root system, and, for this reason, largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops ; although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

Each farmer ought to make his selection, from among the various fodder plants, to suit his individual resources and wants; yet, adopting this basis as his guide, he ought to make his selection on the basis that the crop which is capable of producing, for the same area, the largest quantity of nitrogen containing food constituents, at the least cost, is, as a rule, the most valuable one for him.

Our prominent fodder plants may be classified, in regard to the relative proportion of their nitrogenous organic food constituents to their non-nitrogenous organic food constituents (nutritive ratio), in the following order: —

1. Leguminous plants, clover, vetch, etc.,	1 : 2.2 to 1 : 4.5
2. Grasses,	1 : 5.0 to 1 : 8.0
3. Green corn, roots and tubers,	1 : 6.0 to 1 : 15.0

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind, after it has served its purpose as a constituent of the food consumed.

As the financial success in most farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live stock.

Believing in the correctness of the previous remarks, it has been one of the aims of the manager of the Station to experiment with various new fodder crops, to ascertain their adaptation to our climate and soil, and their fitness for the support of the dairy industry at a period of the season when good hay is scarce, and when the green fodder corn has not yet reached a desirable condition to do its best.

Some, as the vetch, Southern cow-pea and serradella, have been cultivated for several years past on a comparatively large scale, with marked success. They yielded a

liberal amount of green fodder from the beginning of June to the beginning of October. Their good services as green fodder for milch cows during that period have been described in the last annual report (1887, pages 35–48). Similar results have been obtained in this direction during the past season. The details of the feeding experiment form a part of this report.

The observations with reputed fodder crops have been extended during the past year; most of them were, however, raised on a small scale, to ascertain merely their general character and their particular degree of adaptation to our climate and soil, and to secure material for analysis, to compare their relative proportions of essential nutritive constituents.

The fact, as has been stated before, that all these crops are raised under corresponding conditions, as far as climate, soil, modes of cultivation and of fertilization and particular stages of growth are concerned, imparts to the results the claim of an exceptional value to decide judiciously their comparative merits.

1888. — Field "C" comprises at present an area 328 feet long and 183 feet wide. It was ploughed the previous fall, and again April 26; it was harrowed soon after, and fertilized broadcast at the rate of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. The field is divided into two parts, running from east to west; they are separated from each other by a passageway three feet wide.

The northern half of the field is 70 feet wide and 328 feet long; the southern half is of the same length, but 110 feet wide.

The latter is again sub-divided into three equal plats, each 111 × 109 feet, or 11,990 square feet. The east end of this field was planted with a mixture of vetch (*vicia sativa*) and of oats (variety, western). The middle division was planted the same day with serradella, and the western with Southern cow-pea. Vetch and oats were seeded broadcast, and serradella and Southern cow-pea in drills, three feet three inches apart. The northern half of field "C" was occupied by a series of crops in rows,

running from south to north, three feet three inches apart, with the exception of the carrots, which were planted in rows fourteen inches apart. The crops were arranged in the following order, beginning on the east end: —

Danvers carrots, ninety rows.
Welcome oats, three rows.
Hairy vetch (*Vicia villosa*), one row.
Small pea (*Lathyrus sativus*), one row.
Sulla (*Hedysarum coronaria*), one row.
Bird's-foot clover (*Lotus corniculatus*), three rows.
Lotus villosus, three rows.
Sweet clover (*Melilotus alba*), three rows.
Early cow-pea, one row.
Teosinte (*Euchlæna euxurians*), two rows.
Flour corn, one row.
Pop-corn, striped rice, one row.
Chinese sugar cane, seven rows.
Early orange cane, fifteen rows.
Early amber cane, fifteen rows.

The seeds of the plants, with the exception of the carrots, serradella, vetch and Southern cow-pea, were sent on by the United States Department of Agriculture.

Vetch and Oats. — Twenty-five pounds of vetch and fifty pounds of oats were seeded broadcast May 8. The oats appeared above ground May 15, the vetch on May 17. The oats began to head out and the vetch to bloom June 30. Both crops had reached a height of 28 inches July 5, and of 32 inches July 12. The feeding of the crop began July 7 and terminated July 23. The total yield of the green crop amounted to 5,276 pounds, or 8.53 tons, per acre.

Southern cow-peas were seeded in rows, three feet and three inches apart, May 14. They appeared above ground May 28. The plants were six inches high June 27; twelve inches high July 12; and twenty inches high August 3. They began to fill out the space between the rows August 10; bloomed August 17, and formed pods August 23. The feeding of the crop commenced September 4, and was finished September 15. The crop had suffered somewhat from frost September 7. The total yield amounted to 4,050 pounds, or 7.36 tons, per acre.

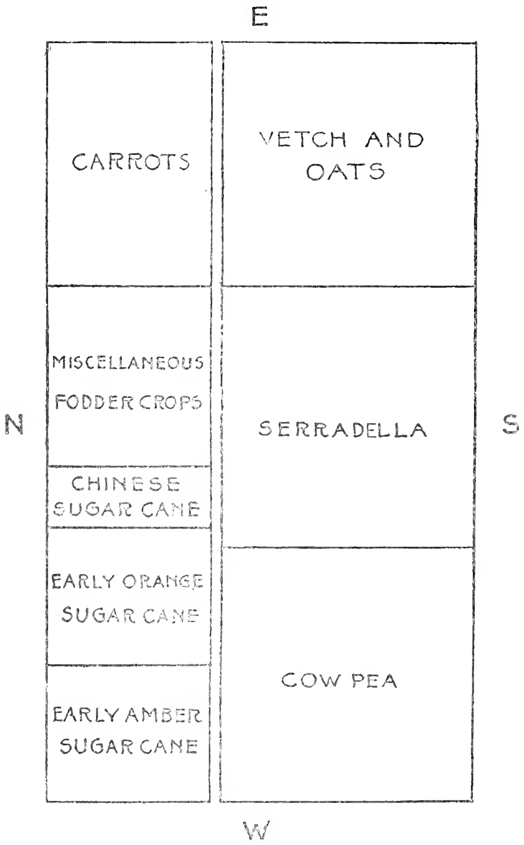
Serradella was planted in rows, three feet three inches apart, May 14. The young plants appeared above ground May 26. They had reached a height of six inches July 5; began blooming July 12, and measured eleven inches, when a blight made its appearance on the leaves, which ultimately destroyed the crop to such an extent that no part of it was fed. The grounds occupied by the serradella had been used during the preceding season for the cultivation of different varieties of wheat, which seriously suffered from fungoid growth. The exceptionally wet season most likely contributed also towards the failure of the crop.

The early frost, September 7, terminated prematurely the observations on Chinese sugar cane, early orange cane and early amber cane.

Teosinte, pop-corn, flour corn, melilotus, sulla, hairy vetch and lotus, have been sampled for analysis.

The perennial varieties of leguminous plants are left in the field for observations during the coming season, when their special agricultural merits will be discussed.

FIELD "C"



·SCALE 4 RODS TO 1 INCH·

IV. Experiments with Potatoes.

The experiments reported in this connection are continuations of those described under the same heading in our last annual report.

One of the experiments has been carried on upon the same portion of field "D" since 1884. It was originally instituted for the purpose of studying the effects of high-grade German potash salts, muriate of potash and potash magnesia sulphate, as the main potash source of plant food, on the quantity and the quality of potatoes raised by their assistance.

The second one, observations with scabby potatoes, owes its origin to the interest created by some observations made in connection with the former; it was carried on, for important reasons, upon a different part of the farm.

A. Observations upon Field "D."

[Variety: Beauty of Hebron.]

An examination of the preceding records of this experiment cannot fail to show that our original plan has been seriously interfered with by an early and persistent appearance of either scab or blight, or of both combined. The scab appeared in some parts of the field sooner than in others, — in the fertilized part of the soil sooner or more extensively than in the unfertilized soil. The results in 1884 were not as bad as in 1885. The seed potatoes used in 1885 were selected from our own crop; they were planted upon the same part of the field where they had been produced the preceding season. The system of manuring and of general treatment was the same as in the previous year. A blight on the leaves appeared that year in August, and terminated the experiment prematurely. The crop, when harvested August 26, was found suffering from scab in all parts of the field engaged in the experiment.

It was decided, in sight of these facts, to continue the experiment in 1886 upon the same field, with some modifications, to ascertain, if possible, whether the main influence regarding the results in our past observation had to be

ascribed to atmospheric agencies, or to the condition of the soil and the fertilizer applied, or to the quality of the seed potato used.

1886. — The same field was used as in 1885. The land was well prepared by ploughing and harrowing April 27, and subsequently fertilized the same as in previous years. The change regarding the character of the fertilizer applied consisted in using nearly twice the amount of potash salts, muriate and sulphate of potash, for the same area, in case of plats 1 and 3. A second important change from our previous practice consisted in securing first quality seed potatoes, in particular free from scab. The same variety, Beauty of Hebron, was obtained for that purpose from Vermont; it was as fair an article as could be desired. The system of planting and cultivating was the same as in previous years. The potatoes were planted upon all plats May 5, 1886. All the vines were in full blossom July 6; they began to turn yellowish and dry up July 30. The crop on the entire field was dried up August 8. This change seemed to appear most marked, and first, on the vines raised from whole potatoes. The crop was harvested August 28.

Neither a liberal use of our own mixture of commercial manurial substances, rich in potash compounds, nor the selection of a fair quality of seed potatoes from another locality, had affected our results, as compared with those of the previous season; for the entire crop, with scarcely any exception, was badly disfigured by scab. The potatoes were unfit for family use, and had to be sold at a low price for stock feeding.

A due consideration of all the circumstances which accompanied our course of observations thus far, induced us to draw the following conclusions: —

1. Medium-sized whole potatoes give better results, as far as a large-sized, marketable crop is concerned, than half potatoes obtained from tubers of a corresponding size.

2. Disregarding the results of the first year, when previously existing resources of plant food in liberal quantities

must have rendered the influences of an additional supply of manurial substances less marked, it appears that sulphate of potash produced better results in our case than muriate of potash.

3. The premature dying out of the vines, accompanied by blight or scab, or both, must be considered a controlling cause of an exceptionally large amount of small potatoes.

4. Some peculiar condition of the soil upon the lands used for this experiment is to be considered the real seat of our trouble. (For further details, see annual report.)

To test the correctness of conclusion 4 still further, the experiment was continued for another year.

1887. — The same plats as in previous years were utilized for the experiment. The subdivisions remained unchanged. The fertilizers applied were the same as in 1886.

The lands were ploughed and harrowed during the first week of May, and the potatoes planted in all plats May 11. First quality potatoes, Beauty of Hebron, raised in Vermont, were used as seed. The growth looked well upon all plats until July 28, when the vines on plats 2 and 3 began to turn yellow. They commenced drying up August 9, and by August 12 were dry on all plats. An examination of the little potatoes, July 1, showed already, in every case, the marks of scab.

The entire crop, when harvested, was so seriously affected by scab that it proved worthless in the general market.

The months of July and August were exceptionally wet and warm in our part of the State, a circumstance which has, most likely, aggravated our trouble.

The potato crop was in that year quite extensively a failure in our vicinity, wherever low lands had been used for its production.

1888. — The continued failure to raise upon this field a potato crop free from a serious attack of scab had strengthened our belief that neither the kind of fertilizer applied, nor

the particular character of the season, nor the quality of the seed potatoes used, had any special relation to our results; but that some peculiar feature of the soil would ultimately prove to be the cause of our trouble.

Assuming that the presence of some injurious parasite in our soil might be the first cause of the scab, it was decided to devise some means by which its development would be prevented. The following course was adopted: Three plats, each forty-four by seventy feet, corresponding in location with plats 1, 2 and 3 in our description of preceding years, were assigned for the observation.

Plat 1, located on the eastern side of the stated area, received the same manure and in the same proportion as in the preceding year (600 pounds of fine-ground bones and 580 pounds of potash-magnesia sulphate per acre). The plat thus fertilized was subsequently subdivided into two equal parts, of which one received broadcast a mixture of one-half a pound of bi-sulphide of carbon and of ninety-five pounds of air-slaked lime; while the other half received broadcast a mixture of one-half a pound of carbolic acid and of ninety-five pounds of air-slaked lime.

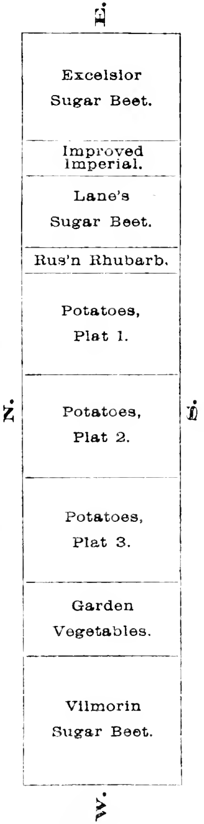
In both instances the soil was subsequently slightly harrowed before the potatoes were planted.

Plat 2, located between plats 1 and 3, received, as in previous years, no fertilizer; but one hundred and ninety pounds of air-slaked lime were sown broadcast and harrowed in before planting. The application of lime was made here to assist in discriminating between the influence of a mere application of air-slaked lime, and that of a mixture of either bisulphide of carbon or carbolic acid and air-slaked lime.

Plat 3, forming the western end of our experimental field, received for manuring purposes, as in the preceding years, fine-ground bones and muriate of potash, at the rate of 600 pounds of the former to 300 pounds of the latter per acre. The fertilizer was applied broadcast and slightly harrowed in. The plat thus prepared, in a similar way to plat 1, was

subsequently subdivided, like the latter, into two equal parts. One part was treated broadcast with a mixture of air-slaked lime and of bisulphide of carbon, and the other one with that of air-slaked lime and of carbolic acid, in the same way, as far as relative portions and total amount are concerned, before planting.

FIELD "D."*



* Scale, 4 rods to 1 inch.

The potatoes were planted on all the plats May 7; they appeared pretty uniform above ground May 27. The general treatment of the crop during the entire time was the same on all plats, and closely corresponded to the course pursued in preceding years. The vines began to change their color August 17, and were all dead August 31. The change seemed to be a natural one; no indications of blight could be discovered on the leaves; the extreme wetness of the season seemed to favor the continuation of the growing period. The crop on all the plats was harvested September 7. An examination of the entire crop, when spread out over the field, showed no marked difference in any particular part of the various plats. The potatoes were of a fair size, but seriously suffering from scab and rot.

Plat 1 yielded 1,080 pounds of potatoes; plat 2, 876 pounds, and plat 3, 976 pounds, of all sizes. Fifteen bushels of scabby potatoes, nearly one-third of the entire crop, were collected before the crop was removed from the field.

Although the results of the year are discouraging, the experiment will be repeated, with some modification, when a more favorable season may assist in the work.

B. Observations with Scabby Potatoes

The experiments were inaugurated in 1886 for the purpose of inquiring into the circumstances which control the development and the propagation of the scab on potatoes.

1886. — The first year's work in this connection has been confined to the task of observing the behavior of scabby potatoes as seed potatoes, under some definite previous treatment. To prevent a possible propagation of scab in the new crop by infected seed potatoes, the following course was adopted: Thoroughly scabby potatoes, obtained from the previously described experimental plats, were treated with some substances known to be destructive to various forms of parasitic growth. This operation was carried out with the intention of destroying the propagating power of adherent germs of an objectionable character before planting the seed.

The field for the experiment was distinctly separate from other experimental plats for the cultivation of potatoes. It had been used for many years previous for the raising of grass, and had since been planted but once, — the preceding year (1885), — with corn. The land was prepared by ploughing and harrowing in the same way as other potato fields. It was fertilized broadcast, at the rate of 600 pounds of ground rendered bones and 290 pounds of potash-magnesia sulphate.

The field was subdivided into five plats of equal size, eighty feet long and fifty feet wide, and the potatoes subsequently planted in rows, three feet three inches apart, with hills three feet from each other in the rows. Three feet of space was left between the plats unoccupied. The scabby seed potatoes selected for the trial were, as far as practicable, of a uniformly medium size. Each lot was immersed in the particular solution prepared for the different plats; after being kept there for twenty-four hours they were removed and directly planted.

Plat 1 was planted with healthy and smooth potatoes, without any previous treatment. This course was adopted to learn whether soil, fertilizer, or atmospheric agencies of the season would favor the appearance of scab in the crop.

Plat 2. The scabby seed potatoes were allowed to remain for twenty-four hours in a saturated solution of muriate of potash before being planted.

Plat 3. A strong solution of hypochlorite of lime (bleaching lime) was applied in a similar way, for the preparation of the scabby seed, as in case of plat 2.

Plat 4. A saturated solution of carbolic acid in water served in this instance for the treatment of the scabby potatoes.

The potatoes were planted in all plats on the same day, May 7. The vines did not appear evenly at first; they were, however, equally vigorous upon all plats at the close of June. The tops on all plats were pretty generally dried up August 8. The potatoes were harvested on the entire field August 30. The yield on all plats was fair, and the quality of the potatoes, almost without exception, excellent; this seemed to be more striking in regard to those on plats 2, 3 and 4, which had been, in the beginning of the season, somewhat behind in growth. Here and there could be seen a potato with a small mark of scab; a large proportion were perfectly smooth, and without any sign of it. The results were recorded as those of a first experiment.

The fact that a scabby potato may produce, under certain circumstances, a smooth and otherwise excellent potato, was confirmed. Good potatoes have been raised before from seed potatoes suffering from scab, without any previous treatment similar to ours. Without any intention of anticipating the results of future observations, or to point out with certainty the exact cause of our results, we expressed the opinion that a difference in the condition of the soil in our old and new experimental potato plats might have proved to be the principal cause of our trouble; for the former yielded, from healthy potatoes, most inferior scabby potatoes; while the latter produced, from scabby potatoes, a most superior, smooth potato, under otherwise almost identical conditions, as far as soil, mode of cultivation and kind of fertilizer were concerned, upon lands in close proximity, during the same season.

1887. — The experiment was repeated upon the same lands, with but a slight modification. The soil was ploughed and fertilized, as in the preceding year. Ten plats, each fifty feet long, were planted with four rows of potatoes, three feet three inches apart, and with nineteen hills in the row. Medium-sized, whole scabby potatoes (Beauty of Hebron), selected from the crop raised upon our own fields during the previous year, and which is described in some preceding pages under the heading "Potato Experiment, A," served as seed potatoes. One-half the plats were planted with scabby potatoes, all from the same lot, after being immersed for eighteen hours in some solution prepared for that purpose; and the other half were planted without any previous treatment of the seed, — plats 2, 6 and 10 with our scabby potatoes, Beauty of Hebron, and plats 4 and 8 with healthy, smooth tubers, of the same variety.

Plat 1. Scabby potatoes, soaked in a solution of potassium sulphide.
Plat 2. Scabby potatoes, without any particular treatment.
Plat 3. Scabby potatoes, treated with a solution of hypochlorite of lime (bleaching lime).
Plat 4. Smooth, healthy potatoes, without previous treatment.
Plat 5. Scabby potatoes, treated with a solution of potassium chloride (muriate of potash).
Plat 6. Scabby potatoes, without previous treatment.
Plat 7. Scabby potatoes, treated with a solution of carbolic acid.
Plat 8. Smooth, healthy potatoes, not treated.
Plat 9. Scabby potatoes, treated with copper sulphate (blue copperas).
Plat 10. Scabby potatoes, not treated.

The young plants made their appearance on all plats, except plat 9, June 1; those on plat 9 appeared eight or ten days later. The entire crop looked uniformly well. The vines dried up on all plats at about the same time. The crop was harvested with the following results: —

BEAUTY OF HEBRON.

PLAT.	Date of Planting.	Condition of Seed.	Solutions Used.	Results (Sept. 12, 1887).
No. 1,	May 12 to 14, 1887.	Scabby.	Potassium sulphide.	Good; not scabby.
" 2,		Scabby.	None.	Good; not scabby.
" 3,		Scabby.	Hypochlorite of lime (bleaching lime).	Especially good.
" 4,		Good.	None.	Somewhat scabby.
" 5,		Scabby.	Potassium chloride (muriate of potash).	Especially good.
" 6,		Scabby.	None.	Good; not scabby.
" 7,		Scabby.	Carbolic acid.	Especially good.
" 8,		Good.	None.	Especially good.
" 9,		Scabby.	Copper sulphide (blue copperas).	Only 7 hills left. More or less scabby.
" 10,		Scabby.	None.	Somewhat scabby.

A careful consideration of these results tends to show that a certain condition of the soil has been the leading cause for the origin and propagation of the scab; for scabby seed potatoes have produced healthy, smooth tubers, both with and without any special previous treatment (see plats 1, 2, 7 and 8). On the other hand, it is not without interest to notice that plats 1, 3 and 7 have furnished us with some of the best potatoes we have raised during the past season.

1888.— The field occupied by the experiment was the same as during the preceding year. The same arrangement of plats was adopted. The preparation of the soil, as far as ploughing and manuring are concerned, was the same as in the preceding season. The solutions of chemicals for the treatment of part of the seed potatoes was identical with that of the preceding year. All the details of the field work, beginning with planting and ending with harvesting, were closely corresponding to the course pursued in 1887.

The potatoes were planted May 9; the vines died on all plats, apparently without any exceptional external cause, between August 23 and 31. No marked difference could be noticed in the appearance of the potatoes from the various plats. All plats had produced some scabby potatoes. The

result of the season is, to say the least, an indifferent one, as far as the action of the various solutions of antiseptics as a preventive of scabby potatoes is concerned.

The conclusion arrived at in previous years has evidently received an additional support by the results of the past season. Every one of our observations thus far made in this connection points towards the soil as the bearer of the cause of the scab on potatoes. The inquiry into the first cause of the scab will be continued.

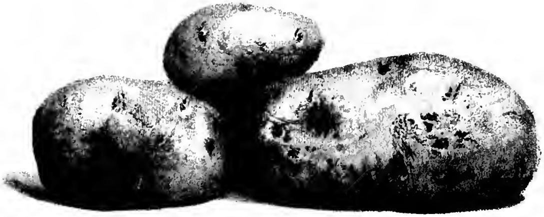
Those of our readers who are not familiar with the present views entertained by scientists regarding the real character of the scab on potatoes, will find Professor Humphrey's discussion of this subject, which accompanies this chapter of our annual report, very interesting and profitable reading.

It has been considered of interest to photograph the seed potatoes, and subsequently some specimens of a corresponding size of those raised from them. This course it is thought will furnish us in time with an exact record of the exterior characteristics of genuine varieties, and assist us in discriminating between new and old. As the Beauty of Hebron, Early Rose and Polaris (originated by H. F. Smith of Waterbury Centre, Vt.) have been the principal varieties raised upon the fields of the Station during the past season, their photographs accompany this report. A picture of the Colorado wild potato, raised on our lands, may not be without interest in this connection. The pictures are in every case taken at an equal distance, and thus allow a comparison of relative sizes.

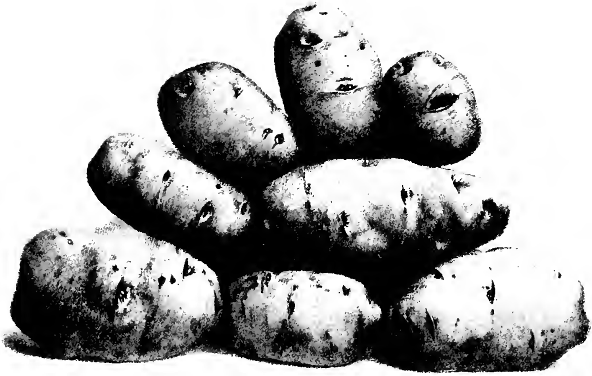
Description of Photographs of Potatoes.

		Largest. Weight in ounces.	Medium. Weight in ounces.	Smallest. Weight in ounces.
Picture No. 1.	Beauty of Hebron Potatoes,	7 to 19	3 to 6½	2½ to 3½
Picture No. 2.	Early Rose Potatoes, . .	4 to 8	2½ to 3½	1½ to 2½
Picture No. 3.	Polaris Potatoes, . .	6 to 11	3 to 5½	2 to 3
Picture No. 4.	Colorado Wild Potatoes, .	–	–	–

No. 1.



Beauty of Hebron (Seed Potatoes for 1888).



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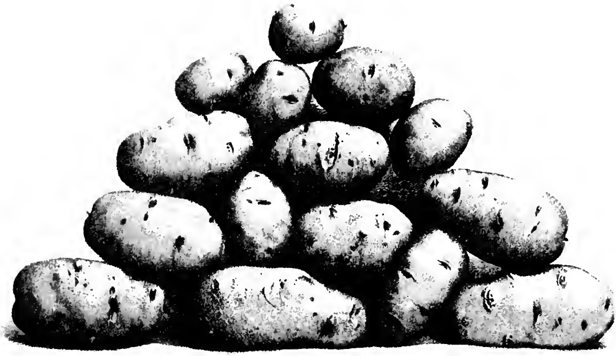
Beauty of Hebron (Potatoes Raised in 1888).

No. 2.

Early Rose (Seed Potatoes for 1888).



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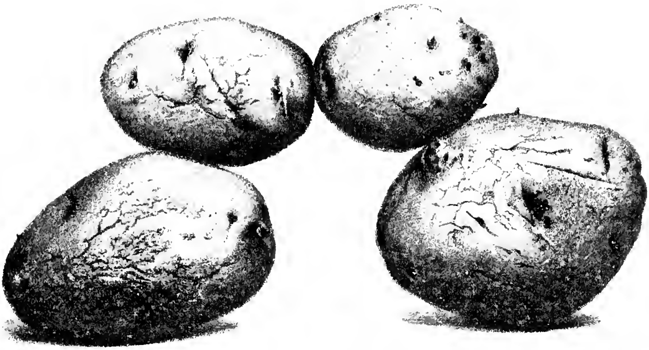
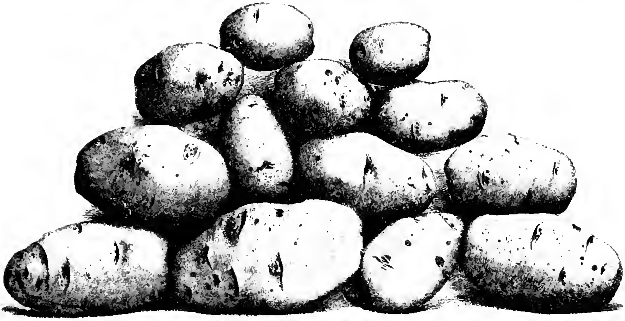
Early Rose (Potatoes Raised in 1888).

No. 3.

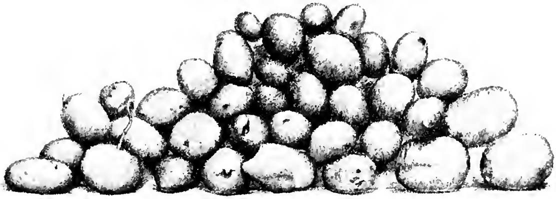


Polaris (Seed Potatoes for 1888).



Polaris (Potatoes Raised in 1888).

No. 4.



Colorado Wild Potatoes (Raised in 1888).

POTATO SCAB.

BY JAS. ELLIS HUMPHREY, PROFESSOR OF VEGETABLE PHYSIOLOGY.

The value of the potato crop in Massachusetts exceeds that of any other planted crop; consequently, the loss by any widespread and serious disease of this crop must be an important item. The commonest and most constant disease which attacks the potato in the field is that commonly known as the "scab." It is well known in both Europe and America, and attacks the tubers, giving little or no evidence of its presence in those parts of the plant above ground. The cause of this trouble is not at all understood, though various theories are held as to its nature. It is proposed in the present paper to discuss briefly the present state of our knowledge of the potato scab, by way of introduction to a series of investigations of the disease which the writer expects to carry on during the coming year.

The disease first manifests itself in the form of small corroded spots or pustules on the surface of the potato. Writers on the subject generally agree that these spots replace the "lenticels" of the tubers.

If a smooth potato tuber be closely examined, there will be seen spots of the size of a pin's head or smaller, of a slightly different shade, and somewhat roughened or granular in appearance. These breaks in the continuity of the tissue of tabular cork-cells which form the so-called "skin" of the potato, are filled with loose, globular cork-cells, through whose intercellular spaces an interchange of gases can take place between the interior of the potato and the outer air. They are then, so to speak, the *ventilators* of the tuber, and are known as "lenticels." (The normal structure of the potato tuber is shown in the accompanying Fig. 2.) It is in these lenticels that the scab originates or first shows itself.

From these spots the disease rapidly spreads, until sometimes almost the whole exterior of the tuber becomes involved in the decay and breaking down of the surface tissue. In many cases, at least, there are developed over these patches, rough, brittle scales or crusts of corky tissue, which peel readily from the surface, and which render the name

"scab" an appropriate one for the disease. In Fig. 1 is shown the appearance of the fully developed scab, reproduced from photographs of potatoes raised on the plats of the Station in 1888. This whole change goes on while the tuber is still in the ground; and after the crop is dug and stored, no further change occurs. The disease affects the tissue to a depth of only a few cells, all below remaining in a normal, healthy condition. The cells affected lose their starch, and contain, in its place, according to some writers, globular brown masses, usually regarded as disorganized cell-contents. In so far as the starch, which gives its chief food value to the potato, is destroyed, that value is lessened; but the unsightly appearance of "scabby" tubers causes a much greater proportional decrease in their selling value, since, by paring away the affected superficial tissue, the remainder is made perfectly suitable for food.

The cause of this disease has been discussed by several writers. Most of the views expressed are based on the first important discussion of the subject by Schacht, in a work on the potato plant and its diseases.* This author believes that the efficient cause of the scab is an excess of moisture in the soil. It can readily be shown, that, when a potato tuber is exposed to an abundance of moisture, the lenticels become more prominent, in consequence of the loosening and separation of the cells which fill them. This affords, Schacht thinks, an easy opportunity for the water to enter those tissues of the tuber bordering the lenticels. They thus become water-soaked, and rapidly decay, assuming a dark and muddy appearance. Two of the chief recent writers on the diseases of plants, Frank and Sorauer, adopt this view. Frank † regards the disease as a case of breaking down of tissue, originating in what is practically a wound. Sorauer ‡ thinks the scab develops rapidly during short but specially favorable periods, and instances, as such a period, the time of a heavy rain following a drought. Each of the above writers mentions as a possible cause, or at least an aggravating condition, the presence of lime, marls, or especially

* Bericht über die Kartoffelpflanze und deren Krankheiten, Berlin, 1854, p. 24.

† Krankheiten der Pflanzen, Berlin, 1880, p. 140.

‡ Handbuch der Pflanzenkrankheiten, Berlin, 1886, vol. i, p. 227.

of iron oxide in the soil; and Sorauer thinks that ammonia set free from the soil may sometimes have a similar influence. Another authority, W. G. Smith,* considers that the chief cause is mechanical irritation, from the presence in the soil of corrosive substances; and states that a difference may often be noticed in the degree of scabbiness of potatoes from different parts of the same field, depending on the relative proportions of refuse in the soil of the different parts. Smith also says that one form of the disease may be caused either by long drought or by excess of moisture. All authors agree that the scab-like crusts, which characterize the disease in its complete development, originate from the natural effort of the plant to repair the injury to the tuber by a secondary formation of cork. Sorauer differs from the others quoted, in rejecting the theory of irritation or corrosion as a primary cause of the trouble. He quotes at length several experiments, conducted in German experiment stations and elsewhere, whose results seem to be conclusive against the idea that foreign substances in the soil can cause the disease by mechanical or chemical action.

We may now proceed to consider the bearing of some recent American observations on the views already stated. The only experiments undertaken in this country for the purpose of testing current theories, with which I am acquainted, are those of Arthur and Beckwith of the New York Experiment Station.† Plats of potatoes were planted and kept under identical conditions, except that half of the hills were kept wet by irrigation, while the others were not artificially watered. One-half of the hills of each class were planted without manure, and the remainder were manured. In the unmanured hills, abundant moisture had practically no influence, for the percentage of scabby potatoes was very nearly the same in the irrigated and unirrigated portions. On the other hand, the irrigated hills on the manured ground produced seventy-one per cent. of scabby tubers, against only thirty per cent. from the unwatered hills. A general average gives forty-eight per cent. of scabby tubers on the irrigated

* Diseases of Field and Garden Crops, London, 1884, p. 37.
† Sixth Annual Report of the New York Agricultural Experiment Station, 1888, pp. 307 and 344.

ground, to thirty-one per cent. on that unirrigated; and fifty-one per cent. of diseased ones on the manured ground, against twenty-two per cent. where manure was not used. These results indicate that an abundance of moisture favors the development of scab, but can hardly be held to support the view that it is the chief *cause* of the disease. Beckwith concludes from his experiments that an increased yield is nearly always accompanied by an increase of scab; and that any marked change in the rapidity of the growth of the tubers favors its development, a continuous growth from their first formation to maturity being least favorable to the appearance of the disease. The last point may, perhaps, be regarded as another aspect of Sorauer's view that a heavy rain after drought especially aids the development of scab.

Observations made at this Station during the past five years, and detailed in its reports,* also bear interestingly on the subject. The experiments were begun with a wholly different end in view, but were vitiated the first year by the appearance of scab, which has persistently appeared on the same plats in every succeeding year. The first year, when the land was freshly broken, the trouble was less severe, and a difference in severity was noticed on plats differently fertilized. Since the first year, the crop has been uniformly scabby, but not more so in wet than in drier seasons. The experiments thus far, while by no means conclusive in their results, seem to point to peculiar soil conditions as the most probable cause of the disease.

In 1887 there appeared a paper by a Norwegian naturalist, Brunchorst,† on a disease of potatoes common in that country, and there called "Skurv," which he believes to be, and which, from his description, seems to be, the same as the German "Schorf" and the English and American "scab." This writer states that the masses noticed by other investigators in the dead cells of the tuber, and by them supposed to be composed of disorganized cell-contents, are really the resting condition of a parasitic organism, whose attacks

* Second to Sixth Annual Reports of Massachusetts Agricultural Experiment Station, 1885–89.

† Ueber eine sehr verbreitete Krankheit der Kartoffelknollen. In Bergens Museums Aarsberetning for 1886, p. 219.

cause the disease. He describes in detail the structure of these masses, as he understands them, but has not seen the supposed parasite in its active state. He names the organism *Spongospora Solani*, and regards it as closely related to *Plasmodiophora Brassicae*, discovered by Woronin * in 1877, and now generally regarded as the cause of the so-called "club foot" or "stump root" disease of cabbages and turnips. For a better understanding of Brunchorst's theory, it may be well to give here a very brief account of the "club foot" parasite.

On emerging from its resting state under the influence of favorable conditions for vegetation, it appears as an almost inconceivably tiny, naked mass of protoplasm, with the power of moving or creeping about in moist soil. Here it may attack a young root of either of several plants of the Mustard family, most commonly of a cabbage or turnip. Penetrating a surface cell, it lives and grows at the expense of the contents of that cell, moving on to another when the first is exhausted. Cells thus attacked increase in size, in consequence of the abnormal stimulus caused by the presence of the parasite, which often also causes a large increase in the number of cells in the affected region. This hypertrophy produces the characteristic swellings which give the disease its name. As a result of the growth and fusion of the protoplasmic masses of the organism, many of the root-cells become at length filled by them. Each of these masses separates, toward the close of the season, into numerous very small globular ones, and each of the latter secretes a wall or coat about itself. In this condition the organism can survive considerable extremes of cold or dryness, and can await the recurrence of favorable conditions. When the weather again permits, the walls or coats crack open, and the contained bits of protoplasm emerge from their rest, each one taking up its active life, and repeating the cycle just outlined. Brunchorst believes the history of his *Spongospora* to be very similar to the above, differing chiefly in the fact that the numerous masses, into which the parasitic contents of one cell divide, remain angular and closely compacted into a spongy structure, instead of becoming

* Pringsheim's Jahrbücher für wissenschaftliche Botanik, vol. xi, p. 548.

globular and separate, as in *Plasmodiophora*. In Fig. 3 are shown the active and resting stages of the latter, and Brunchorst's representation of the resting state of his supposed scab parasite.

Both the New York and the Massachusetts observations, before referred to, bear on Brunchorst's views. If the scab is caused by a living organism, its development must be checked by the application of substances fatal to parasitic forms of life; and scabby potatoes would be expected to produce usually a scabby crop, when planted, the infected tubers infecting the new generation. Experiments with fungicides, at both stations named, gave only negative results, the decrease in scabbiness where they were used being insignificant. The average proportion of scabby tubers produced from scabby "seed" in the New York experiments was forty-five per cent, while smooth "seed" yielded thirty-seven per cent. of diseased potatoes At our own Station the crops have varied little in quality, when raised under similar conditions, whether from smooth or scabby "seed;" and badly diseased tubers have, in several cases, produced exceptionally good crops.

One further observation, noted by Beckwith in the report quoted, is of interest. He finds that, while forty-three per cent. of the white-skinned potatoes and fifty-three per cent. of the flesh-colored ones raised on the station farm were scabby, only twenty-seven per cent. of the dark-skinned ones were affected. Assuming the cause of the disease to be external to the tuber, such a result was to be expected.

From the above statement, it is evident that much remains to be learned before our knowledge of the cause of the potato scab will be at all satisfactory. And, until a pretty definite knowledge of its cause is gained, all attempts at discovering a remedy are so many leaps in the dark. The conditions at this Station are in many respects very favorable for a hopeful prosecution of investigations into the nature and origin of the pest, which are planned for the coming season. The writer will be very glad of suggestions or reports of experience from persons who have had to do practically with the disease, or to communicate with any who are interested in this subject of inquiry.

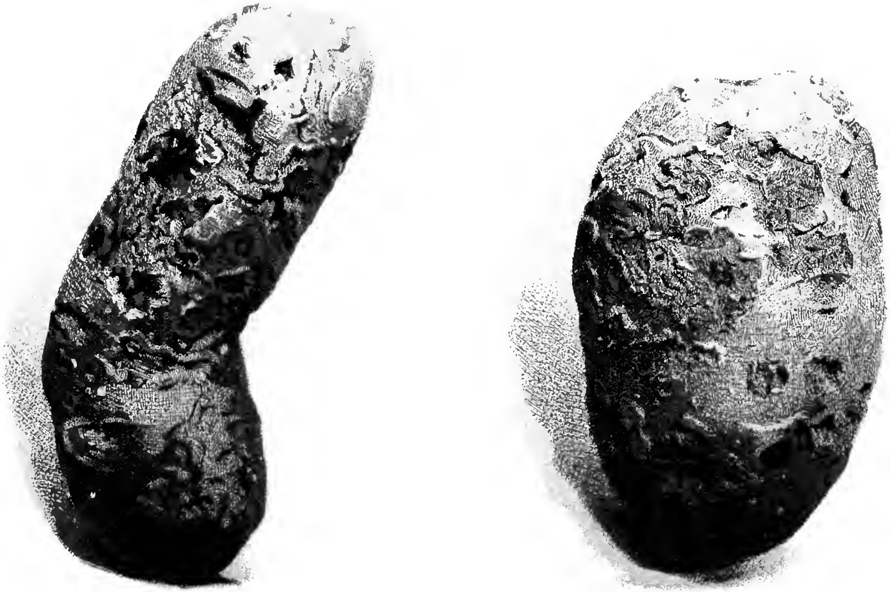


FIG. 1.

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FIG. 1.

WRIGHT & POTTER PRINTING CO. STATE PRINTERS.

Fig. 1. Two potatoes, "Beauty of Hebron," from Station plats, badly affected by "scab," illustrating the usual form of the disease. *From photographs.* Five-sixths natural size.

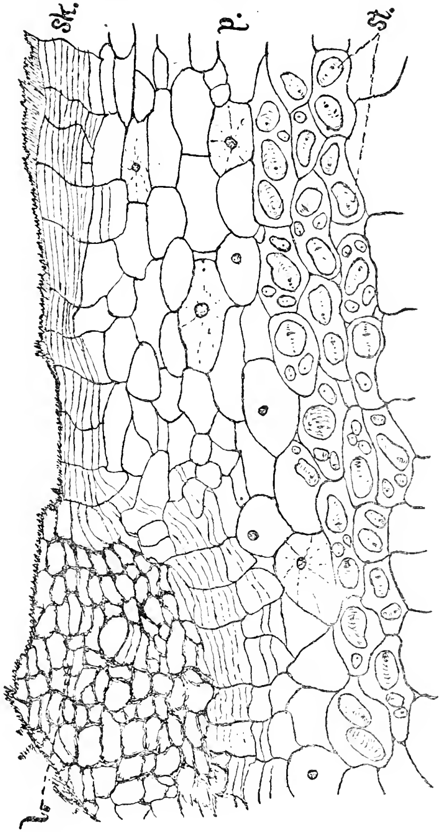


Fig. 2.

Fig. 2. Section taken at right angles to the surface of a healthy potato tuber, showing its normal structure.

sk. The "skin" of the tuber, of tabular cork-cells.

l. A lenticel, filled with rounded cork-cells.

p. The parenchymatous tissue, which forms the bulk of the tubers, containing starch-grains, *st.*

Original. Magnified one hundred diameters.

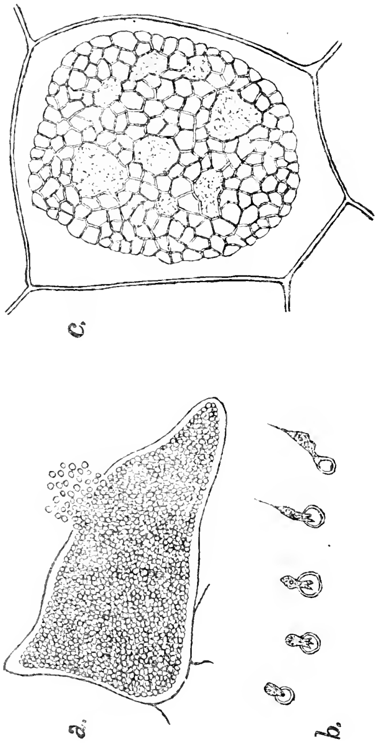


Fig. 3.

Fig. 3. *a.* Cell from diseased root of cabbage, showing resting stage of *Plasmodiophora Brassicae, Woronin*, the "club-foot" parasite.

b. Protoplasmic masses of *P. brassicae* emerging from the resting state.

c. Cell from scabby potato, showing resting stage of *Spongospora Solani, Brunchorst*, the supposed "scab" parasite.

a and b, after Woronin. *a* magnified one hundred diameters, *b* magnified six hundred diameters.

c, after Brunchorst. Magnified one thousand diameters.

V. Experiments with Root Crops.

The importance quite generally conceded to the introduction of a liberal cultivation of root crops in a mixed farm management, wherever a deep soil and the general character of the climate favors their normal development, rests mainly on the following consideration: They furnish an exceptionally large amount of valuable vegetable matter, fit for fodder for various kinds of farm live stock, competing in this direction favorably with our best green fodder crops; and they pay well, on account of large returns, for the necessary care bestowed upon them by a thorough, deep cultivation to meet success.

The physical condition of the soil, however favorable it may have been for the production of crops of a similar character, will suffer if year after year the same system of cultivation is carried out. Diversity in the mechanical treatment of the soil, and change of season for such treatment, cannot otherwise but affect advantageously its mechanical condition and the degree of its chemical disintegration, promoting thereby its fitness for developing inherent plant food, as well as its power of turning to account atmospheric resources of plant growth. The roots of the same plants abstract their food year after year from the same layer of soil, while a change of crops with reference to a different root system renders it possible to make all parts of the agricultural soil contribute in a desirable succession towards an economical production of the crops to be raised. Deep-rooting plants, like our prominent root crops, for this reason deserve a particular consideration in the planning of a rational system of rotation of crops.

To raise roots the second year, after a liberal application of coarse barn-yard manure, or the turning over of grass lands with the assistance of some commercial phosphatic fertilizer in the interests of a timely maturity, is highly recommended by practical cultivators of sugar beets. To stimulate in the roots the production of the largest possible amount of sugar and starch must be the object of the cultivator, for these two constituents of roots control, more than any other one, their increase in solids.

Root crops, although somewhat peculiar in their composition when compared with many of our prominent fodder articles, have proved a very valuable constituent in the diet of various kinds of farm live stock, when properly supplemented by hay, grain, oil cake, bran, etc., as circumstances may advise. Our experience at the Experiment Station confirms fully the valuable services of roots as an ingredient of fodder rations for milch cows. (For details on this point, see "Feeding Experiments with Milch Cows," in our fourth and fifth annual reports.)

The encouragement received on that occasion has served as an inducement to continue our work in this direction. The aim has been to experiment with the best varieties of roots at our disposal. The preceding annual report contains a short sketch of the field work carried out during the year 1887. The different varieties of roots raised had been photographed, and copies taken by the heliotype process accompanied the report. The discussion of their composition and of their comparative agricultural value had to be left for a later date, on account of the closing up of the annual report before that work was finished. The same course we are obliged to pursue, for the same reason, in regard to our field experiments with root crops during the late season (1888). Our present communication comprises, first, the analyses of roots raised in 1887; and second, a description of the work carried on in the field with different varieties of valuable roots for feeding purposes.

1. *Analyses of Roots raised upon the Lands of the Station in 1887.*

The seeds used in our experiments were sent on by the United States Department of Agriculture, with the exception of No. 7, — Saxony sugar beet, — which was taken from our collection of imported seeds. The field work was planned with a view to ascertain the general character and the particular composition of the different varieties of roots on trial, when raised, as far as practicable, under corresponding circumstances with reference to the peculiarity of season, the quality of soil, the system of manuring and the mode of cultivation.

The land consisted of a good loam in a fair condition of fertilization. It has been manured for several years past, annually, with a mixture consisting of six hundred pounds of fine-ground bone and two hundred pounds of muriate of potash per acre. The seeds, ten varieties in all, were sown May 25. Each variety occupied two rows across the field, of equal length (eighty feet).

No. 1. Beet, Mangel Wurzel, "Giant Long Red."
2. Beet, Mangel Wurzel, "Yellow Ovoid."
3. Beet, "Eclipse."
4. Beet, "Red Globe."
5. Beet, "Egyptian Turnip."
6. Beet, "Long Smooth Red."
7. Beet, "Saxony" Sugar Beet.
8. Turnip, Ruta-baga, "White Sweet German."
9. Turnip, "Early Yellow," or "Golden Stone."
10. Turnip, Ruta-baga, "Skirving's Purple Top."

The rows were three feet three inches apart. The young plants were in every case thinned out or transplanted, as circumstances advised, to about eight inches distant from each other in the rows.

The transplanting and thinning out took place between July 5 and 11; the weather during this time was favorable for transplanting. The seeds of Nos. 6 and 9 did not prove as good as the others; the young plants of Nos. 5 and 9, in particular, did not do as well after transplanting as the remainder.

The crop was harvested between October 31 and November 2. The roots, after being removed from the ground, were topped, and three of each kind were taken to the laboratory for a chemical examination, while three of an approximately corresponding size were photographed.

The three sample roots selected in each case represented, as far as practicable, the smallest, medium and largest of each variety raised.

The specimens selected for our fodder analyses were kept in the cellar, slightly covered with moist earth, until wanted for the chemical examination.

The photographs were taken in every case with the roots at an equal distance from the camera. (See illustrations, pages 148–150, in our last annual report.)

Statement of Field Results.

	NAME OF VARIETY.	Number of Rows.	Number of Roots.	Weight of Roots.	Weight of three Samples photographed.
				lbs.	lbs.
1.	Mangel Wurzel, "Giant Long Red,"	2	150	365	11.75
2.	Mangel Wurzel, "Yellow Ovoid,"	2	177	350	9.75
3.	Beet, "Eclipse,"	2	163	285	4.
4.	Beet, "Red Globe,"	2	173	335	7.5
5.	Beet, "Egyptian Turnip,"	2	146	170	8.75
6.	Beet, "Long Smooth Red,"	2	145	185	5.
7.	Sugar Beet, "Saxony,"	2	144	314	8.75
8.	Ruta-baga, "White Sweet German,"	2	176	445	4.
9.	Turnip, "Early Yellow," or "Golden Stone,"	2	43	50	5.5
10.	Ruta-baga, "Skirving's Purple Top,"	2	140	295	12.75

Beets.

[I. Mangel Wurzel, "Giant Long Red," weight, 2 lbs. II. Mangel Wurzel, "Yellow Ovoid," weight, 2 lbs. 3 oz. III. "Eclipse," weight, I lb. 4 oz.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	86.92	87.66	Not determined.*
Dry matter,	13.08	12.34	
	100.00	100.00	
Analysis of Dry Matter.			
Crude ash,	8.35	11.01	8.86
" cellulose,	9.54	7.21	4.29
" fat,	.90	1.01	.85
" protein (nitrogenous matter),	7.83	10.45	10.09
Non-nitrogenous extract matter,	73.38	70.32	75.91
	100.00	100.00	100.00

* The sample had suffered a loss in original moisture from exposure.

Fertilizing Ingredients in the Above Beets.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	86.92	87.66	–
Nitrogen,	.171	.206	.282
Phosphoric acid,	.102	.085	.156
Potassium oxide,	.305	.462	.587
Calcium oxide,	.064	.059	.062
Magnesium oxide,	.047	.031	.045
Sodium oxide,	.145	.105	.055
Ferric oxide,	.006	.004	.005
Insoluble matter,	.028	.018	.043
Valuation per 2,000 lbs.,	$0 94	$1 17	$1 62

Beets.

[IV. "Red Globe," weight, 1 lb. 2 oz. V. "Egyptian Turnip," weight, 1 lb. 2 oz. VI. "Long Smooth Red," weight, 1 lb. 10 oz.]

	Per Cent.		
	IV.	V.	VI.
Moisture at 100° C.,	86.95	85.80	85.49
Dry matter,	13.05	14.20	14.51
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	10.57	5.80	8.99
" cellulose,	4.52	6.23	5.47
" fat,	1.76	.82	.79
" protein (nitrogenous matter),	12.17	7.82	11.80
Non-nitrogenous extract matter,	70.98	79.33	72.95
	100.00	100.00	100.00

Fertilizing Ingredients in the Above Beets.

	Per Cent.		
	IV.	V.	VI.
Moisture at 100° C.,	86.95	85.80	85.49
Nitrogen,	.264	.177	.236
Phosphoric acid,	.079	.070	.087
Potassium oxide,	.525	.303	.377
Calcium oxide,	.044	.049	.040
Magnesium oxide,	.025	.035	.044
Sodium oxide,	.110	.061	.099
Ferric oxide,	.004	.002	.003
Insoluble matter,	.013	.018	.028
Valuation per 2,000 lbs.,	$1 42	$0 92	$1 20

Sugar Beet.

[VII. "Saxony," weight, 1 lb. 11 oz.]	Per cent.
Moisture at 100° C.,	83.32
Dry matter,	16.68
	100.00

Analysis of Dry Matter.

Crude ash,	5.09
" cellulose,	5.81
" fat,	.39
" protein (nitrogenous matter),	7.32
Non-nitrogenous extract matter,	81.39
	100.00

Fertilizing Ingredients in Sugar Beet.

Moisture at 100° C.,	83.32
Nitrogen,	.209
Phosphoric acid,	.136
Potassium oxide,	.383
Calcium oxide,	.052
Magnesium oxide,	.034
Sodium oxide,	.113
Ferric oxide,	.025
Insoluble matter,	.032
Valuation per 2,000 lbs.,	$1 18

Turnips.

[VIII. Ruta-baga, "White Sweet German," weight, 2 lbs. 2 oz. IX. "Early Yellow" or "Golden Stone," weight, 14 oz. X. Ruta-baga, "Skirving's Purple Top," weight, 2 lbs. 11 oz.]

	Per Cent.		
	VIII.	IX.	X.
Moisture at 100° C.,	87.23	87.20	88.40
Dry matter,	12.77	12.80	11.60
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	8.81	8.01	9.24
" cellulose,	11.04	10.96	11.60
" fat,	1.23	1.42	2.32
" protein (nitrogenous matter),	10.34	10.81	11.16
Non-nitrogenous extract matter,	68.58	68.80	65.68
	100.00	100.00	100.00

Fertilizing Ingredients in the Above Turnips.

	Per Cent.		
	VIII.	IX.	X.
Moisture at 100° C.,	87.23	87.20	88.40
Nitrogen,	.211	.221	.207
Phosphoric acid,	.136	.116	.125
Potassium oxide,	.546	.412	.452
Calcium oxide,	.106	.117	.080
Magnesium oxide,	.030	.033	.027
Sodium oxide,	.051	.133	.141
Ferric oxide,	.002	.009	.004
Insoluble matter,	.001	.072	.017
Valuation per 2,000 lbs.,	$1 32	$1 22	$1 21

The closing months of the summer season of 1887 were marked by an exceptional amount of rainfall. The serious influence of that circumstance showed itself in various direc-

tions in our vicinity. Some crops in low localities suffered more or less a premature decay, others did not reach their full maturity in due time. Our root crop, judging from the results of our examination, evidently did not reach its full perfection on account of the exceptional wetness of the latter part of the growing season. The moderate amount of dry vegetable matter found in the well-studied variety of Saxony sugar beet, as well as the large proportion of the nitrogen most of them contained in other combinations than in that of true albuminoid substances, entitle to that conclusion. Root crops are commonly reported to contain on an average from thirty-five to forty-five per cent. of their nitrogen in other and less valued combinations than the typical albuminous matter or the genuine protein substances. An examination of the subsequent tabular statement of some tests in that direction shows that our roots, as far as they have been submitted to an actual observation (1–7), contained from fifty-two to seventy per cent. of their nitrogen in various combinations quite generally considered of less nutritive value than the group of typical albuminous substances. The last-named class of compounds reaches usually its highest attainable proportions in a plant or part of a plant at the state of maturity.

Determination of Albuminoid Nitrogen in Roots raised upon the Fields of the Station.

	Per Cent.		
	Total Nitrogen.	Albuminoid Nitrogen.	Non-Albuminoid Nitrogen.
Root No. 1, ...	1.20	0.58	0.62
" 2, ...	1.61	0.55	1.06
" 3, ...	1.53	0.56	0.97
" 4, ...	1.90	0.57	1.33
" 5, ...	1.20	0.58	0.62
" 6, ...	1.81	0.51	1.30
" 7, ...	1.25	0.60	0.65

The various kinds of roots usually raised on farms for feeding purposes differ essentially in regard to the amount of dry vegetable matter they contain. Turnips contain from seven to eight per cent.; ordinary mangolds from eleven to twelve per cent.; improved varieties of beet roots, like Lane's, from fifteen to sixteen per cent.; good carrots from fourteen to fifteen per cent.; a good sugar beet from eighteen to twenty per cent. of solids; or, in other words, one ton of an improved variety of good sugar beets is equal to from two to two and one-half tons of ordinary turnips, as far as the amount of dry vegetable matter is concerned.

Modes of cultivation and of manuring exert a decided influence in this direction on the composition of the roots. Large roots of the same variety contain quite frequently less solid matter than the smaller ones. Close cultivation in the rows, in connection with the use of well-decomposed manurial matter as fertilizer, tends to produce good results.

The difference in the amount of solids, as far as each kind of root is concerned, is otherwise due, in the majority of cases, to a more or less perfect maturity. A liberal manuring with potash and nitrogen, in connection with a scanty supply of phosphoric acid, is frequently the cause of immatured roots at the ordinary harvest time.

2. *Field Observations with Root Crops in 1888.*

The field used for the work was of the same character as in the preceding trial. It represents a part of field "D" on our records, and is 328 feet long and 70 feet wide. The main field runs from east to west, and the rows run in all cases from south to north. The soil consists of a deep, sandy loam, and has been fertilized for several years annually with the same fertilizer, six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. Some of the land has been used before for the raising of root crops. It was ploughed in the autumn, 1887, and again on April 26, 1888. The fertilizer was applied April 30, in the customary way, broadcast, and slightly harrowed in before planting. The rows were seventy feet long and three feet three inches apart. The seed was taken partly from our own imported stock of previous years, and

partly chosen from varieties sent on by the United States Department of Agriculture at Washington, D. C. The following varieties were seeded May 17 and 19: —

		Rows.
No. 1.	Excelsior Sugar Beet,	15
2.	Improved Imperial Sugar Beet,	6
3.	Vilmorin Sugar Beet,	14
4.	Lane's Sugar Beet,	9
5.	New Market Gardener Beet (red),	1
6.	Eclipse Beet (red),	1
7.	Osborn's Selected Beet (red),	1
8.	Yellow Danver's Carrot,	90

One row was planted with Saxony sugar beet, from our crop of 1887, for the purpose of raising seeds for our own consumption during the coming season.

The young plants appeared in all cases above ground May 28; they were in every instance, whenever necessary, thinned out to have them eight inches apart in the rows; none were transplanted.

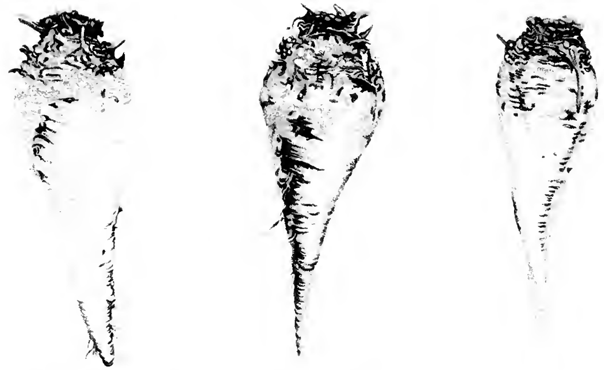
The average number of roots in a row was at the end of the season as follows: —

	Plants.
Excelsior Sugar Beet,	89
Improved Imperial Sugar Beet,	96
Vilmorin Sugar Beet,	119
Lane's Sugar Beet,	105
New Market Gardener Beet,	67
Eclipse Beet,	118
Osborn's Selected Beet,	122

The entire yield of each of these varieties of beet roots without tops amounted to, —

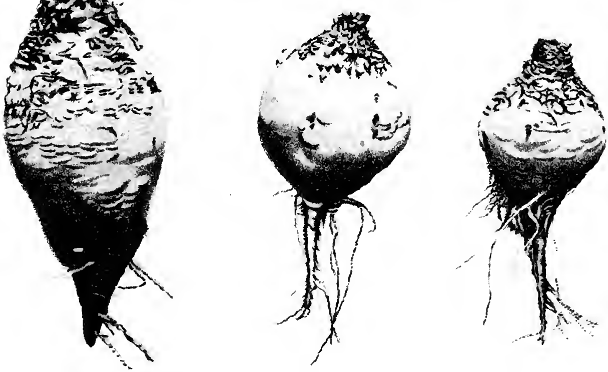
1,870 pounds in fifteen rows of Excelsior.
1,070 pounds in six rows of Improved Imperial.
3,355 pounds in fourteen rows of Vilmorin.
1,250 pounds in nine rows of Lane's.
125 pounds in one row of New Market Gardener.
150 pounds in one row of Eclipse.
130 pounds in one row of Osborn's Selected.

The Vilmorin sugar beet exceeds in our case in yield all other sugar beets, allowing an equal number of rows with an equal number of plants. The yield per acre, with rows three feet and three inches apart, at our rate of production would amount to 22.95 tons.



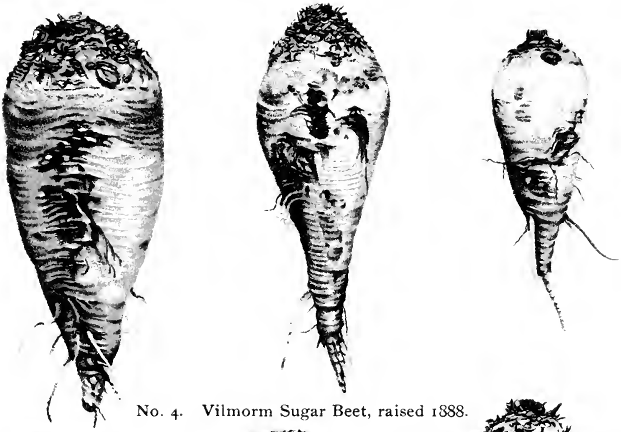
No. 1. Saxony Sugar Beet, raised 1887.

No. 2. Excelsior Sugar Beet, raised 1888.

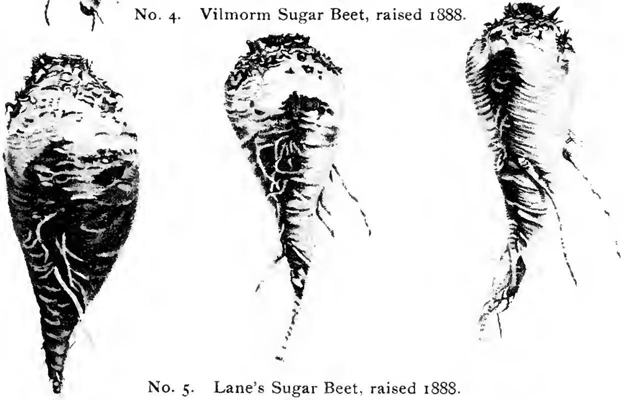


No. 3. Improved Imperial Sugar Beet, raised 1888.

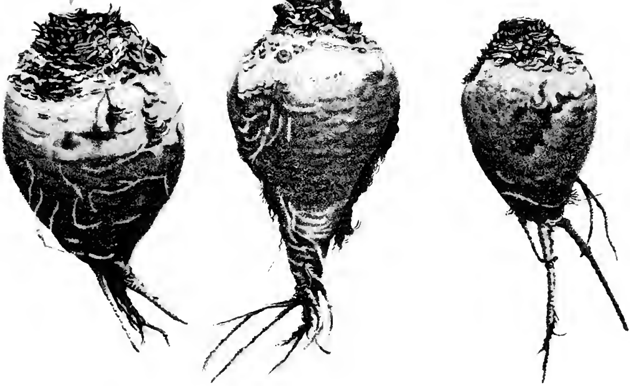
Wright & Potter Printing Co., State Printers



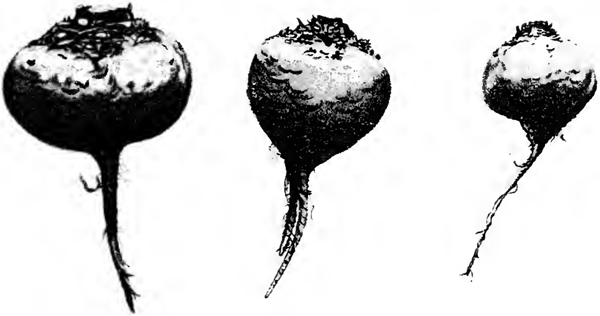
No. 4. Vilmorm Sugar Beet, raised 1888.



No. 5. Lane's Sugar Beet, raised 1888.



No. 6. New Market Gardener Beet, raised 1888.



No. 7. Eclipse Beet (red), raised 1888.

No. 8. Osborn's Selected Beet (red), raised 1888.

No. 9. Danver's Carrot (yellow), raised 1888.

WRIGHT & POTTER PRINTING CO. STATE PRINTERS

The crop was harvested October 22. The entire season was remarkable for its exceptional coolness in July, and its abundance of rain. The leaves retained even to the time of harvesting a considerable degree of vitality.

Carrots (*Danver's Yellow*). — This crop occupied an area of 109 by 70 feet; the field was manured in the same way and with the same quantity of fine-ground bones and muriate of potash as the one which served for the raising of the above-mentioned varieties of roots. The soil was in both instances practically of a corresponding character, and in a corresponding state of fertilization. The seed was planted in rows, fourteen inches apart, June 1. The young plants appeared above ground June 17; the crop was kept clean from weeds by the use of the hand and the cultivator. The roots were harvested October 31; they amounted to 6,850 pounds, or 137 bushels, at 50 pounds each, which is equal to 19.52 tons per acre.

Samples of all the varieties of roots raised at the Station have been carefully collected and at once photographed, to present a concise idea of their peculiarity, as far as their exterior is concerned. Analyses of each kind will be presented later on. Three samples of every variety, representing the largest, middle and smallest size of each, served the photographer. The picture was in each case taken at a corresponding distance, to allow comparison of size. The weight of each is also stated.

TABULAR STATEMENT OF WEIGHTS OF ROOTS PHOTOGRAPHED.

		Largest.	Medium.	Smallest.
Picture No. 1.	Saxony Sugar Beet,*	–	–	–
" 2.	Excelsior Sugar Beet,	2 lbs. 14 oz.	1 lb. 15 oz.	1 lb. 5 oz.
" 3.	Improved Imperial Sugar Beet,	4 " 4 "	2 " 4 "	1 " 5 "
" 4.	Vilmorin Sugar Beet,	5 " 0 "	2 " 7 "	1 " 2 "
" 5.	Lane's Sugar Beet,	2 " 15 "	1 " 9 "	1 " 7 "
" 6.	New Market Gardener Beet,	4 " 7 "	3 " 14 "	1 " 14 "
" 7.	Eclipse Beet,	2 " 11 "	1 " 13 "	0 " 12 "
" 8.	Osborn's Selected Beet,	2 " 11 "	1 " 9 "	1 " 2 "
" 9.	Danver's Carrot,	0 " 13 "	0 " 11 "	0 " 6 "

* Total weight of 3 sizes, 8 lbs. 12 oz.

VI. Notes on Miscellaneous Field Work.

Aside from the strictly experimental work on our older field, much preparatory work has been carried on during the past year on our more recent addition of lands. The older field, which has been for six years under our control, is located along the west side of the highway leading from Amherst to North Amherst; it covers an area of about twenty acres, including the grounds occupied by the present buildings of the Experiment Station. The more recent addition of lands (1886) is located along the east side of the highway; it covers an area of thirty acres, of which ten acres are occupied by a natural forest growth. The entire field forms the western slope of a prominent elevation. Most of the cultivated portion, which consisted of old grass lands, is gradually slanting towards the north-west, while a considerable portion of it is nearly on a level, with a slight depression towards the north. The entire area, consisting essentially of a good gravelly loam, admits of a satisfactory management of the work to be carried on upon it. The steeper portion along the wood land will be used for experiments with large and small fruits, the adjoining part towards the west for experiments with general farm crops, and the more level western termination for permanent grass lands. This plan for its future use was adopted after taking possession of the grounds in 1886.

As the lands along the slope are somewhat springy, and as its lower portion has at times to convey to the north a considerable amount of water coming from adjoining southern hillsides, a thorough system of underdraining was at once devised, and in its essential direction carried out, before any of the sod was turned over. Subsequently, during the autumn of 1886, the northern end of the entire field, to the extent of twelve acres, was ploughed; while the ploughing of the southern terminus of the field, comprising eight acres of old grass land, was for financial considerations reserved for a year later (1887).

The ploughed lands were thoroughly treated with a wheel harrow during the succeeding spring, before planting. Wood

ashes, at the rate of one ton per acre, was the only fertilizer used during the first season. This mode of manuring these lands was adopted for the purpose of assisting in a rapid decomposition of a rank growth, and of bringing the soil, as far as practicable, to a corresponding state of fertilization in the interest of future experiments. A variety of crops was subsequently planted, with the main aim to secure, in every instance, a thorough mechanical working of the soil by drill cultivation or by the use of the hoe. Several varieties of barley and of oats, corn, potatoes, squashes, and a variety of other garden crops, occupied the field. The periodical stirring of the soil promised to free the land from a foul growth, which in the course of time naturally overruns old grass lands.

During the month of September about seven acres of the entire cultivated area were prepared for a permanent meadow, and seeded down with a mixture of herd's grass and red-top; some varieties of clover were added the succeeding spring (1888).

The southern end of the field, which had still served, as above stated, for the production of hay, was turned over late in the season, to be prepared during the succeeding spring for future experiments in the same manner as the north end.

1888. — The preparatory work has been continued in all parts of this field. The exceptional rainfall has seriously tested the capacity of our drain tiles; they have stood the test, on the whole, satisfactorily. Needed alterations have been attended to, and the prospects are that no further serious trouble may be expected. No fertilizers but wood ashes have been used thus far. Drill cultivation has been generally adopted, to assist in future cultivation. Several acres of oats, barley and corn have been raised, to assist in the support of feeding experiments. The permanent grass lands have been increased here to from nine to ten acres. Definite grass mixtures have been used as seed, to test their respective merits in our locality. The results will be carefully watched, from a botanical as well as from an economical stand-point. An orchard will be laid out during the coming year.

The subsequent statement contains an enumeration of the principal crops raised in different parts of the farm, on lands either permanently assigned for the production of fodder for the live stock of the Station, or engaged in a course of preparation for future experiments: —

	Tons
Good English hay,	23
Rowen,	9
Corn stover,	$3\frac{1}{2}$
Corn fodder,	$4\frac{1}{2}$
Roots (carrots and sugar beets),	7
Oats (grain and straw),	$4\frac{1}{4}$
Barley (grain and straw),	2
Green fodder (vetch, oats and cow-pea),	$4\frac{1}{2}$
Crops for ensilage (corn, $9\frac{1}{2}$ tons; Soja bean, cow-pea and Hungarian grass, $3\frac{1}{2}$ tons),	13
Potatoes (mainly Beauty of Hebron, Early Rose and Polaris),	260 bush.

From four to five acres of Southern cow-pea, Soja bean, horse bean, lupine and buckwheat have been subjected to drill cultivation, for the purpose of renovating old grass lands and to serve ultimately as green manure.

NEW LAWS

FOR THE

REGULATION OF THE SALE OF COMMERCIAL FERTILIZERS.

Work in the Chemical Department.

I. Fertilizer Laws and Fertilizer Analyses.

II. Miscellaneous Analyses.

The Legislature of 1888, at the suggestion of the State Board of Agriculture, has enacted a new law, entitled, "An Act to regulate the Sale of Commercial Fertilizers," chapter 296. This Act, which has been in operation since Sept. 1, 1888, assigns the supervision of the sale of commercial fertilizers to the director of the Massachusetts State Agricultural Experiment Station at Amherst, Mass.

The provisions of the Act are as follows: —

[Chap. 296.]

An Act to regulate the sale of commercial fertilizers.

Be it enacted, etc., as follows:

Section 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes, sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers

which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

SECT. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SECT. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients, namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, or offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence and one hundred dollars for each subsequent offence.

SECT. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

SECT. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in presence of said party or parties in interest or their representative, and taken from a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples, and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing; and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be made substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*

The above-stated regulations are now in force, and a compliance with them is imperative on all manufacturers, importers, agents or sellers of any brand of commercial fertilizer or of any material used for manurial purposes, the retail selling price of which is ten dollars or more per ton.

It will be noticed that the new provisions for the control of the trade in fertilizers in Massachusetts apply not only, as heretofore, to a certain class of more or less compound, distinct brands of commercial fertilizers, but to all materials, single or compound, used for manurial purposes, without regard to source, when offered for sale at ten dollars or more per ton.

The official report of analyses and of all materials used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted to a statement of chemical composition, and to such additional information as relates to the former. This change, it is expected, will tend to direct the attention of the consumer of fertilizers more towards the composition of the different brands of fertilizers offered for sale.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. Those who are not yet familiar with the current market value of fertilizing constituents may benefit by a short discussion of that subject at the close of this chapter.

The approximate market value of different brands of fertilizers, obtained by the current mode of valuation, does not express their respective agricultural value, *i.e.*, their crop-producing value. The higher or lower market price of different brands of fertilizer does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated, and the special wants of the crop to be raised by their assistance. To select judiciously from among the various brands of fertilizers offered for patronage requires in the main two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question contains the guaranteed quantities and qualities of essential articles of plant

food at a reasonable cost, and that it contains them in such form and in such proportions as will best meet existing circumstances and special wants. In some instances it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three.

A remunerative use of commercial fertilizers can only be secured by attending carefully to the previously stated considerations.

The new duties assigned to the director of the Station render it necessary to discriminate in the future, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general, between analyses of samples collected by a duly qualified delegate of the Experiment Station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

More detailed information in this connection, regarding the duties of the director of the Massachusetts State Agricultural Experiment Station, and the obligations of the manufacturers, dealers and agents engaged in the sale of commercial fertilizers or materials used for manurial purposes, may be obtained by addressing the director at Amherst, Mass. Copies of the above-printed Act may be had on application.

I.—Analyses of Commercial Fertilizers collected during the Past Season in the General Markets, by the Agent of the Massachusetts Agricultural Experiment Station.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
1	"Americus" Ammoniated Bone Superphosphate,	Williams & Clark Co., New York City, N. Y.,	Springfield.
2	"Americus" Potato Fertilizer,	" " " "	"
3	H. L. Phelps' Complete Manure; Guano and Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
4	H. L. Phelps' Phosphate,	" " " "	"
5	H. L. Phelps' Complete Manure for Corn and Grain,	" " " "	"
6	Bradley's XL Superphosphate of Lime,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
9	Crocker's Potato, Tobacco and Hop Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	"
10	Mapes' Corn Manure,	Mapes Formula and Peruvian Guano Co., New York City,	"
12	Mapes' Potato Manure,	" " " " "	"
14	Bowker's Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
15	Stockbridge's Manure for Vegetables,	" " " "	"
20	Randall's Combined Bone and Potash,	Benj. Randall, Boston, Mass.,	Boston.
23	Crocker's Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Concord.
24	Standard Superphosphate,	Standard Fertilizer Co., Boston, Mass.,	Boston.
25	Allen Fertilizer,	American Manufacturing Co., Boston, Mass.,	"
26	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	"
60	Swan Island Guano,	. . . .	Springfield.
61	Hargrave's Ground Bone,	Hargrave Manufacturing Co., Fall River, Mass.,	Amherst.
62	Cotton-seed Hull Ashes,	. . . .	Whately.
63	Cotton-seed Hull Ashes,	. . . .	South Deerfield.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1	"Americus" Ammoniated Bone Superphosphate,	14.87	2.91	2–3	9.63	0.61	0.41	10.65	11–13	10.24	10–12	2.54	2–3*
2	"Americus" Potato Fertilizer,	10.85	3.97	3–4	6.35	1.01	1.63	8.99	7–8	7.36	6–8	7.94	8–10*
3	H. L. Phelps' Complete Manure; Guano and Potash,	8.94	6.50	3.3–4.1	3.34	2.39	3.26	8.99	–	5.73	4–5	6.12	5–7
4	H. L. Phelps' Phosphate,	9.75	3.71	2.5–3.3	5.46	2.98	2.70	11.14	10–12	8.44	–	3.75	3–4
5	H. L. Phelps' Complete Manure for Corn and Grain,	9.74	4.07	4.1–5	5.83	1.64	4.47	11.94	8–10	7.47	6–8	7.19	7–8
6	Bradley's XL Superphosphate of Lime,	14.57	3.03	2.5–3.25	9.44	0.64	3.71	13.79	11–14	10.08	9–11	1.84	2–3*
9	Crocker's Potato, Tobacco and Hop Phosphate,	13.32	2.71	2–3	8.01	3.01	2.29	13.31	8–12	11.02	8–12	4.09	3.5–4.5*
10	Mapes' Corn Manure,	12.73	4.40	3.7–4.1	6.66	2.37	4.42	13.45	10–12	9.03	–	6.36	6–7
12	Mapes' Potato Manure,	9.98	4.08	3.7–4.4	4.22	3.53	6.18	13.93	8–10	7.75	6–8	6.72	6–8*
14	Bowker's Hill and Drill Phosphate,	13.06	3.27	2.5–3.25	7.84	2.98	2.31	13.13	11–14	10.82	10–12	2.25	2–3*
15	Stockbridge's Manure for Vegetables,	11.03	3.77	3.25–4.25	6.21	3.11	1.68	11.00	–	9.32	8–10	4.04	5–6
20	Randall's Combined Bone and Potash,	12.33	2.33	1.6–2.5	2.29	5.10	7.04	14.43	13–16	7.39	5–7	2.44	2–3
23	Crocker's Ammoniated Bone Superphosphate,	11.32	3.20	2.9–3.7	7.87	1.01	2.92	11.80	–	8.88	8–12	1.22	1–3*
24	Standard Superphosphate,	10.85	3.56	2.25–3.25	9.05	1.92	3.04	14.01	11–16	10.97	9–13	1.83	2–4
25	Allen Fertilizer,	21.14	2.50	2.0–3.1	5.45	2.47	1.79	9.71	6–10	7.92	5–8	5.19	4–6
26	Darling's Animal Fertilizer,	17.08	4.08	3.3–5	2.67	2.04	5.84	10.55	10–12	4.71	–	4.16	4–6
60	Swan Island Guano,	14.97	0.52	–	–	4.15	16.77	20.92	–	4.15	–	0.89	–
61	Hargrave's Ground Bone,	12.43	2.68	3.93	0.13	6.20	19.34	25.67	18.8	6.33	4–12	–	–
62	Cotton-seed Hull Ashes,	8.90	–	–	–	–	–	9.76	–	–	–	26.66	–
63	Cotton-seed Hull Ashes,	10.15	–	–	–	–	–	15.37	–	–	–	19.07	–

* Sulphate of potash, the source of potash.

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
27	Standard Superphosphate,	Standard Fertilizer Co., Boston, Mass.,	Boston.
30	Soluble Pacific Guano,	Pacific Guano Co., Boston, Mass.,	Concord.
35	Darling's Lawn Dressing,	L. B. Darling Fertilizing Co., Pawtucket, R. I.,	Boston.
36	Cumberland Superphosphate,	Cumberland Bone Co , Portland, Me.,	Fitchburg.
38	Chittenden's Complete Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Conn.,	North Hadley.
39	Chittenden's Complete Fertilizer for Potatoes,	" " " " "	South Deerfield.
40	Pequot Fish and Potash,	Quinnipiac Co., New London, Conn.,	"
42	Soluble Pacific Guano,	Glidden & Curtis, Boston, Mass.,	Plymouth.
45	Baker's A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York City, N. Y.,	New Bedford.
49	Tucker's Imperial Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Taunton.
52	Original Bay State Bone Superphosphate,	" " " "	W. Bridgewater.
53	Darling's Fine Ground Bone,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Cochesett.
54	Dow's Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	"
67	The Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
68	E. Frank Coe's High Grade Am. Bone Superphosphate,	E. Frank Coe, New York City, N. Y.,	Lowell.
74	Dole's 203 Fertilizer,	Dole Fertilizer Co., Boston, Mass.,	"
77	E. Frank Coe's Alkaline Bone,	E. Frank Coe, New York City, N. Y.,	"
85	Great Eastern General Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Pittsfield.
115	Bradley's Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Co., Boston, Mass.,	Mendon.
117	Brightman's Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Swansea.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds. Found.	Nitrogen in 100 Pounds. Guaranteed.	Phosphoric Acid in 100 Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 Pounds. Found.	Potassium Oxide in 100 Pounds. Guaranteed.
27	Standard Superphosphate,	14 86	3.41	2.25–3.25	8.60	2.09	2.94	13.63	11–16	10.69	9-13	2.96	2–4
30	Soluble Pacific Guano,	12 54	2.97	2.25–3	7.16	1.58	3.54	12.28	10.5–16	8.74	8.5–12	3.21	2–3.5
35	Darling's Lawn Dressing,	19.85	5.25	5–6.5	2.12	3.88	4.05	10 05	9–11	6.00	–	5.20	4–6
36	Cumberland Superphosphate,	14.55	2.89	2–4	6.17	2.95	3.58	12.70	12–14	9.12	9-13	2.57	2–3
38	Chittenden's Complete Tobacco Fertilizer,	9.45	3.07	3.3–5	3.87	5.28	3.45	12.60	8–10	9.15	6–8	4.26	*
39	Chittenden's Complete Fertilizer for Potatoes,	11.41	3.23	3.2–4.2	4.51	3 94	2.97	11.42	8–10	8.45	6–8	5.75	6–8
40	Pequot Fish and Potash,	23.25	3.40	2.5–3.3	0.35	3.37	2.11	5.83	–	3.72	3–5	4.22	4–6*
42	Soluble Pacific Guano,	14.20	3.00	2 25–3	7 87	1.11	1.77	10.75	10.5–12	8.98	8.5–12	2.29	2–3.5
45	Baker's A. A. Ammoniated Superphosphate,	19.32	3.40	1.7–3.2	10.40	1.23	0.14	11.77	–	11.63	10–12	3.18	2–3
49	Tucker's Imperial Bone Superphosphate,	21.29	2.45	2–2 5	5.98	1.73	2.70	10.41	9–10	7 71	7-8	2 98	*
52	Original Bay State Bone Superphosphate,	18.78	3.00	2.5–2 9	7.20	1.57	2.40	11.19	10–12	8.79	9–9.5	1.38	2–3
53	Darling's Fine Ground Bone,	5.79	2.95	3.5–4.5	–	7.42	17.31	24.73	22–25	7.42	–	–	–
54	Dow's Nitrogenous Superphosphate,	16.88	2.76	2.1–2.9	4.80	3.90	2.16	10.86	8–10	8.70	–	2.57	–
67	The Lawrence Fertilizer,	13.51	1.86	2.1–2.9	8.85	2.78	2.57	14.20	10–12	11.63	–	4.21	6
68	E. Frank Coe's High Grade Am. Bone Superphosphate,	9.42	2.62	2–2.5	8.37	1.51	2.17	12.05	11–13	9.88	9–12	2.34	*
74	Dole's 203 Fertilizer,	11.14	3.12	3–4	4.16	2.88	3.80	10.84	10–12	7.04	8–10	3.09	3–4
77	E Frank Coe's Alkaline Bone,	10.24	1.94	0.8–1.6	8.64	1.42	1.97	12.03	11–15	10.06	9–12	2.77	*
85	Great Eastern General Fertilizer,	12.35	2.95	2.9–3.7	5.37	3.31	2.58	11.26	9–15	8.68	8–12	2.01	2–4
115	Bradley's Complete Manure for Potatoes and Vegetables,	15.24	3.93	3.7–4.5	8.96	2.78	1.44	13.12	9–12	11.74	8–10	6.57	6–7
117	Brightman's Fish and Potash,	27.11	3.22	2.5–4.1	0.69	2.87	2 23	5.79	6.9	3.56	–	2.67	2–3

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
8	Bradley's Dry Fish Guano,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
31	Americus Ammoniated Bone Superphosphate,	Williams & Clark Co., New York City, N. Y.,	Concord.
43	Bay State Fertilizer,	Clark Cove Guano Co., New Bedford, Mass.,	Plymouth.
64	Ames' Bone Fertilizer,	A. L. Ames, Peabody, Mass.,	Ipswich.
66	Common Sense Fertilizer,	Common Sense Fertilizer Co., Boston, Mass.,	Haverhill.
80	Lowell Bone Fertilizer,	Josiah M. Butman, Lowell, Mass.,	Chelmsford.
81	Jefferds' Animal Fertilizer,	John Jefferds, Worcester, Mass.,	Greenfield.
82	Crocker's Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	"
87	Orient Complete Manure,	Orient Guano Manufacturing Co., Long Island, N. Y.,	Lee.
91	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
95	E. Frank Coe's Potato Fertilizer,	E. Frank Coe, New York City, N. Y.,	Westfield.
118	Chittenden's Complete Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Conn.,	South Deerfield.
119	N. Ward's High Grade Animal Fertilizer,	N. Ward & Co., Boston, Mass.,	Boston.
120	Mayo's Superphosphate,	Mayo & Hix, Boston, Mass.,	Weston.
121	Whittemore Bros.' Fertilizer,	Whittemore Bros., Wayland, Mass.,	Wayland.
124	Economic Fertilizer, No. 3,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.
127	Cleveland's Superphosphate,	Cleveland Dryer Co., Boston, Mass.,	Lowell.
128	Lister's Success Fertilizer,	Lister's Agricultural Chemical Works, Newark, N. J.,	"
17	Williams & Clark Co.'s Potato Phosphate,	Williams & Clark Co., New York City, N. Y.,	Worcester.
32	Bradley's X L Superphosphate,	Bradley Fertilizer Co., Boston, Mass.,	Westborough.
109	Pacific Guano Co.'s Fish and Potash,	Pacific Guano Co., Boston, Mass.,	South Amherst.
130	Cotton-seed Hull Ashes,	. . . .	Boston.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds. Found.	Nitrogen Guaranteed.	Phosphoric Acid in 100 Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 Pounds. Found.	Potassium Oxide Guaranteed.
8	Bradley's Dry Fish Guano,	7.25	8.83	8.2-9.9	0.41	2.91	3.05	6.37	6-8	3.32	-	-	-
31	Americus Ammoniated Bone Superphosphate,	15.09	3.26	2-3	9.07	1.52	-	10 59	11-16	10.59	10-12	2.71	2-3
43	Bay State Fertilizer,	12.07	3.22	2.1-2.8	8.24	0.98	1.50	10.72	9 5-14	9.22	9-11	2.51	2-3
64	Ames' Bone Fertilizer,	16.76	4.02	3.3-4.5	5.94	4.01	1.02	11.00	11-13	9.98	-	0.98	1
66	Common Sense Fertilizer,	11.14	1.74	2-4	0.03	7.16	2 53	9.72	9-14	7.19	-	1 83	1-2
80	Lowell Bone Fertilizer,	9.88	2.65	2-3	4.96	6.51	2.03	13.50	10-14	11.47	6-10	2.91	2-4
81	Jefferds' Animal Fertilizer,	5.39	3.88	4.1-5.8	0.18	6.15	11.19	17.52	14-16	6.33	-	6.04	5-7
82	Crocker's Potato, Hop and Tobacco Phosphate,	7.71	2.65	2-3	8.50	0.85	1.00	10.36	9-14	9.35	8-12	4.04	3.5-4.5*
87	Orient Complete Manure,	11.11	2.54	1.7-2.5	7.52	1.53	-	9.05	10-17	9.05	8-12	1.87	1-2.5*
91	Adams' Market Bone Fertilizer,	12.67	4.10	2.5-3.5	1.30	6.14	3.64	11.08	8-10	7.41	6-8	4.52	3-5
95	E. Frank Coe's Potato Fertilizer,	14.64	1.91	1.7-2.5	7.87	0.81	1.57	10 25	-	8.68	8-10	3.71	*
118	Chittenden's Complete Tobacco Fertilizer,	10.08	3.16	3.3-5	5.42	4.94	1.58	11.94	8-10	10.36	6-8	6.38	*
119	N. Ward's High Grade Animal Fertilizer,	14.43	3.69	2.88-3.7	5 69	5.37	1.41	12.47	-	11.06	12-14	3.89	4-5
120	Mayo's Superphosphate,	9.33	2.61	2.5-3	8.03	1.78	1.80	11.61	11.5-13.5	9 81	10.5-11.5	3.27	3-4
121	Whittemore Bros.' Fertilizer,	17.65	2.38	2.5-3.3	6 91	5.99	0.90	13.80	-	12.99	8-12	3.81	3-4
124	Economic Fertilizer, No. 3,	9.33	0.27	0.25-0.75	0.06	1.63	9.13	10.82	6-9	1.69	-	0.13	-
127	Cleveland Superphosphate,	7.73	2.71	2.05-2.55	7.74	3.19	3.18	14.11	10-13	10.93	8-10	2.14	3-4*
128	Lister's Success Fertilizer,	13.15	1.87	1.2-1.7	6.68	3.17	2.57	12.42	-	9 87	10.5-12	1.50	1.5-2*
17	Williams & Clark Co.'s Potato Phosphate,	14.46	3.03	2-3	7.21	2.30	5.91	15.48	8-10	9.54	7-10	5 61	6-8*
32	Bradley's XL Superphosphate,	15.78	3 07	2.5-3 25	7.26	2.87	2.12	12.25	11-14	10.13	9-11	1.99	2-3*
109	Pacific Guano Co.'s Fish and Potash,	13.90	2 65	2.5-3.3	3.44	3.05	3.12	9.61	6-9	6.49	4-7	5.28	4-6
130	Cotton-seed Hull Ashes,†	6.51	-	-	-	-	-	3.11	-	-	-	17.37	-

* Sulphate of potash, the source of potash. † Insoluble matter, 39.29 per cent., exceptionally large.

TABLE I. — *Continued.*

LABORATORY No.	NAME OF BRAND.	NAME OF MANUFACTURER.	SAMPLED AT.
21	Randall's Market Garden Fertilizer,	Benjamin Randall, Boston, Mass.,	Boston.
22	Stockbridge's Manure for Strawberries,	Bowker Fertilizer Co., Boston, Mass.,	Concord.
34	Breck's Lawn and Garden Dressing,	Standard Fertilizer Co., Boston, Mass.,	Boston.
69	Darling's Pure Dissolved Bone Superphosphate,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Ipswich.
71	The Allen Fertilizer for Corn,	American Manufacturing Co., Boston, Mass.,	Reading.
86	E. Frank Coe's High Grade Fish Guano and Potash,	E. Frank Coe, New York City, N. Y.,	Westfield.
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Pittsfield.
99	H. Preston & Son's Ammoniated Bone Superphosphate,	H. Preston & Son, Greenpoint, Long Island,	"
104	Quinnipiac Phosphate,	Quinnipiac Fertilizer Co., New London, Conn.,	Williamstown.
107	Pacific Guano Co.'s Fish and Potash,	Glidden & Curtis, Boston, Mass.,	"
108	Geo. W. Miles' IXL Ammoniated Bone Superphosphate,	Geo. W. Miles, Milford, Conn.,	Amherst.
122	Bartlett's Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.
129	Lister's Celebrated Bone,	Lister's Agricultural Chemical Works, Newark, N. J.,	Lowell.
131	Church's Fish and Potash,	Jos. Church & Co., Tiverton, R. I.,	Somerset.

Table I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
21	Randall's Market Garden Fertilizer,	14.52	3.83	2.9–3.3	4 61	3.24	2.25	10.10	–	7.85	8.5-11	4.12	4-5
22	Stockbridge's Manure for Strawberries,	10.90	3 38	2.88–3.7	4 16	2.96	4.55	11.67	7-9	7.12	6-7	3.29	4-5
34	Breck's Lawn and Garden Dressing,	8.68	5.42	4.1–5	6.54	1.91	1.34	9.82	–	8.48	8–9	4 67	4-6
69	Darling's Pure Dissolved Bone Superphosphate,	11.01	2 40	2.06–2.47	6.12	10.45	1.16	17.73	16–18	16.57	15-17	–	–
71	The Alien Fertilizer for Corn,	20.77	2.42	2.06–3 09	4 54	1.72	1.44	7.70	6–10	6.26	5-8	2.91	4-6
86	E. Frank Coe's High Grade Fish Guano and Potash,	12.07	2.66	3.3-4.1	2.08	2.36	5.25	9.69	–	4 44	6-8	3.26	*
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	12.07	2.95	2.06–2.88	6 05	2.42	2.09	10.57	9–15	8.47	8-12	5.98	6-8
99	H. Preston & Son's Ammoniated Bone Superphosphate,	15.12	2.50	2 47–3 3	5.04	2.24	3.42	10.70	–	7.28	9-10	1.86	2-3
104	Quinnipiac Phosphate,	15.69	3 23	2.75–3 25	8.11	2.20	1.11	11.24	–	10.31	9-12	2.34	2-3*
107	Pacific Guano Co.'s Fish and Potash,	11.78	3.47	2.47–3.3	4.27	1.94	2.64	8.85	6–9	6.21	4-7	6.55	4-6
108	Geo. W Miles' IXL Ammoniated Bone Superphosphate,	19.18	2.27	2 06–3.3	7.75	1.69	1.10	10.54	–	9.44	8-12	2.20	1-3
122	Bartlett's Bone,	4.41	2.28	–	0.25	15.78	13.79	29 82	–	16.03	–	–	–
129	Lister's Celebrated Bone,	10.62	3.51	2.7–2 9	0.51	9.29	3.13	12.93	12–14	9.80	–	–	–
131	Church's Fish and Potash,	26 55	3.62	3.71–4.12	1.62	2.32	0.79	4.91	5–6	3.94	–	4.28	3.5-4*

* Sulphate of potash, the source of potash.

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
16	Stockbridge's Manure for Seeding Down,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
28	Stockbridge's Manure for Grass, Top Dressing and Forage Crops,	" " " "	Ware.
29	Stockbridge's Manure for Potatoes,	" " " "	"
37	Seeding Down Fertilizer,	Cumberland Bone Co., Portland, Me.,	Fitchburg.
41	Quinnipiac Dry Ground Fish,	Quinnipiac Fertilizer Co., New London, Conn.,	South Deerfield.
46	Baker's Complete Grass Manure,	H. J. Baker & Bro., New York City,	New Bedford.
47	Baker's Special Corn Fertilizer,	" " "	"
51	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Cochesett.
55	Brightman's Dry Ground Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.,	"
56	Brightman's Fish and Potash,	" " " "	"
58	Dow's Grass Fertilizer,	John C. Dow & Co., Boston, Mass.,	"
65	Farmers' New Method Fertilizer,	Bradley Fertilizer Co., Boston, Mass.,	Newburyport.
70	The Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
76	The Lawrence Fertilizer,	" " " "	"
83	Jefferds' Fine Ground Bone,	John Jefferds, Worcester, Mass.,	Greenfield.
84	Adams' Market Bone Fertilizer for Potatoes,	Adams & Thomas, Springfield, Mass.,	Springfield.
88	Church's Fish and Potash,	Jos. Church & Co., Tiverton, R. I.,	"
123	Economic No. 1,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
16	Stockbridge's Manure for Seeding Down,	12.81	3.20	2.5–3.3	4.22	2.91	6.40	13.53	–	7.13	14–15	3.22	4–5
28	Stockbridge's Manure for Grass, Top Dressing and Forage Crops,	15.23	5.28	5.5–6.5	3.94	1.67	4.61	10.22	6–8	5.61	5–6	2.85	2.5–3.5
29	Stockbridge's Manure for Potatoes,	10.38	3.98	3.25–4.25	5.90	2.23	2.59	10.72	9–11	8.13	7–9	4.82	5–6
37	Seeding Down Fertilizer,	16.27	1.89	1.60	1.55	5.91	16.14	23.60	18–20	7.46	5–9	0.26	1
41	Quinnipiac Dry Ground Fish,	7.63	7.94	7.5–10	0.50	2.31	3.77	6.58	–	2.81	4–6	–	–
46	Baker's Complete Grass Manure,	18.50	4.34	3.71	5.28	0.62	–	5.90	–	5.90	5	7.68	7.5
47	Baker's Special Corn Fertilizer,	10.47	5.81	4.12	1.65	5.23	0.10	6.98	7.25–9.25	6.88	6.25	6.55	7
51	Darling's Animal Fertilizer,	15.07	3.48	3.3–4.94	2.70	4.90	2.92	10.52	10–12	7.60	–	4.95	4–6
55	Brightman's Dry Ground Fish Guano,	14.02	7.18	8.21–9.89	0.38	2.30	6.22	8.90	6.8–9.16	2.68	–	–	–
56	Brightman's Fish and Potash,	23.59	2.90	2.5–4.1	1.48	2.21	1.08	4.77	6.8–8.2	3.69	2–3	3.35	2–3
58	Dow's Grass Fertilizer,	12.48	3.50	3.3–4.12	0.72	2.75	7.52	10.99	12–14	3.47	–	3.04	2–3
65	Farmers' New Method Fertilizer,	14.90	1.32	0.82–1.82	8.60	0.93	1.06	10.59	10–12	9.53	8–10	1.50	*
70	The Lawrence Fertilizer,	13.29	1.73	2.06–2.88	8.28	2.38	2.97	13.63	10–12	10.66	–	4.86	10
76	The Lawrence Fertilizer,	12.62	1.67	2.06–2.88	9.60	2.66	2.94	15.20	10–12	12.26	–	0.58	2–3
83	Jefferds' Fine Ground Bone,	9.03	1.86	2.47–3.3	0.13	7.73	21.68	29.54	27–30	7.86	–	–	–
84	Adams' Market Bone Fertilizer,	9.58	3.95	2.5–3.5	1.38	4.34	5.47	11.19	8–10	5.72	6–8	5.30	3–5
88	Church's Fish and Potash,	26.48	2.48	3.71–4.12	1.91	2.74	0.35	5.00	5–6	4.65	–	4.22	3.5–4*
123	Economic No. 1,	11.68	1.71	1–2	–	0.61	4.22	4.83	2–4	0.61	–	0.19	–

* Sulphate of potash, the source of potash.

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
7	Bone and Potash (Circle Brand),	Bradley Fertilizer Co., Boston, Mass.,	Springfield.
33	Randall's Farm and Field,	Benj. Randall, Boston, Mass.,	Boston.
59	Dow's Ground Bone,	J. C. Dow & Co., Boston, Mass.,	Cochesett.
75	Unicorn Brand Ammoniated Superphosphate,	Clark's Cove Guano Co., New Bedford, Mass.,	Ipswich.
78	Bradley's Sea Fowl Guano,	Bradley Fertilizer Co., Boston, Mass.,	"
89	World of Good Tobacco Grower,	Thomson & Edwards Fertilizer Co., Chicago, Ill.,	North Hatfield.
90	Original Coe's Superphosphate of Lime,	Bradley Fertilizer Co., Boston, Mass.,	Shelburne Falls.
92	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Co., Bridgeport, Conn.,	Pittsfield.
93	Great Eastern General Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Glendale.
100	Chittenden's Universal Phosphate,	National Fertilizer Co., Bridgeport, Conn.,	Pittsfield.
101, 105, 112	Soluble Pacific Guano,	Glidden & Curtis, Agents, Boston, Mass.,	Williamstown.
102	Williams & Clark Co.'s Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Co., New York,	Great Barrington.
103	E. Frank Coe's High Grade Ammoniated Superphosphate,	E. Frank Coe, New York,	North Adams.
110	Geo. W. Miles' Fish and Potash Manure,	Geo. W. Miles, Milford, Conn.,	Amherst.
125	Economic No. 4, for Potatoes,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.
132	Darling's Fine Ground Bone,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	
134	Cotton-seed Hull Ashes,	. . . .	Granby.

Table I. — *Concluded.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
7	Circle Brand of Bone and Potash,	8.04	2.05	1.9-2.6	2.98	4.08	6.55	13.61	8-12	7.06	-	1.72	2-3
33	Randall's Farm and Field,	19.34	2.50	1.6-2.7	4.99	2.65	1.57	9.21	10-16	7.64	8-11	2.20	2-4
59	Dow's Ground Bone,	9.11	2.76	2.06-2.47	0.67	3.20	13.97	17.84	18-22	3.87	-	1.95	3-4
75	Unicorn Brand Ammoniated Superphosphate,	12.91	2.37	1.8-2.5	4.67	2.05	3.79	12.51	10-13	8.72	8.5-10	3.40	2.25-3
78	Bradley's Sea Fowl Guano,	16.55	2.41	2.5-3.25	8.25	2.70	2.03	12.98	11-14	10.95	9-11	1.90	2-3*
89	World of Good Tobacco Grower,	6.81	1.66	3.30-4.11	5.85	1.57	4.73	12.15	10-12	7.42	-	1.35	*
90	Original Coe's Superphosphate of Lime,	14.82	3.36	2.05-2.25	7.28	2.96	1.25	11.49	10-13	10.24	8-10	1.18	1-2*
92	Chittenden's Ammoniated Bone Superphosphate,	13.81	2.41	1.5-2.47	5.44	2.43	5.18	13.05	9-11	7.87	7-9	2.78	2-4
93	Great Eastern General Fertilizer,	13.09	3.74	2.88-3 71	5.22	3.50	2.81	11.53	9-15	8.72	8-12	1.87	2-4
100	Chittenden's Universal Phosphate,	8.48	2.73	2.06-2.88	2.21	4.99	8.54	15.74	11-12	7.20	9-11	3.20	2-3
101, 105, 112	Soluble Pacific Guano,	11.51	3.23	2.25-3	6.26	2.89	2.67	11.82	10.5-16	9.15	8.5-12	1.97	2-3.5
102	Williams & Clark Co.'s Ammoniated Bone Superphosphate (Americus Brand),	13.57	3.22	2-3	6.78	2.97	0.49	10.24	11-16	9.75	8-9	3.78	2-3*
103	E. Frank Coe's High Grade Ammoniated Superphosphate,	10.72	2.52	2-2.5	7.80	1.27	2.83	11.90	11-13	9.07	9-12	2.16	*
110	Geo. W. Miles' Fish and Potash Manure,	13.45	3 02	2.47-4.12	5.37	2.91	1.31	9.59	7-10	8.28	6-7	4.46	3-5
125	Economic No. 4, for Potatoes,	12.15	0.69	0.25-0.75	0.25	0.84	5.28	6.37	2-4.5	1.09	-	0.56	-
132	Darling's Fine Ground Bone,	8.12	3.60	3.5-4.5	0.17	9.12	14 75	24.13	22-25	9.29	-	-	-
134	Cotton-seed Hull Ashes,	13.50	-	-	-	-	-	8.83	-	-	-	20.97	-

* Sulphate of potash, the source of potash.

II.—Analysis of Commercial Fertilizers and Manurial Substances sent on for Examination.

Wood Ashes.

[I. Sent on from Ipswich, Mass. II. and III. Sent on from Concord, Mass]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.24	14.50	14.13
Calcium oxide,	38.30	33.34	33.45
Magnesium oxide,	2.82	3.83	3.39
Potassium oxide,	2.55	5.76	6.32
Phosphoric acid,	1.83	1.28	1.40
Insoluble matter (before calcination),	21.58	14.96	14.83
Insoluble matter (after calcination),	19.81	9.95	11.67

Sample I. contains but one-half the amount of potash of an ordinary quality of Canada wood ash. Samples II. and III. are of a good quality, and correspond fairly with the guaranty of the dealer. The question has been repeatedly asked, on what basis to adjust differences between a stated guaranty of composition and the actual results of an analysis of a sample of wood ash. Our answer has been, in these cases, to allow $5\frac{1}{2}$ cents for every pound of potassium oxide and 6 cents for every pound of phosphoric acid which the analysis shows to be less than the guaranty states to be present.

Wood Ashes.

[I. Sent on from Amherst, Mass. II. Sent on from Amherst, Mass. III. Sent on by F. H. Greeley, Salisbury, Mass. IV. Sent on by J. D. W. French, North Andover, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.67	19.14	7.29	17.14
Phosphoric acid,	1.25	1.72	3.09	5.04
Calcium oxide,	39.06	30.16	45.22	35.59
Potassium oxide,	5.38	4.76	4.37	4.22
Magnesium oxide,	2.88	3.04	4.27	6.45
Insoluble matter (before calcination),	17.42	21.72	18.14	17.47
Insoluble matter (after calcination),	8.79	13.45	11.23	12.19

[V. Sent on by C. F. Clark, Boston, Mass. VI. Sent on by Coolidge Bros., South Sudbury, Mass. VII. and VIII. Sent on by Fred L. Ames, Boston, Mass.]

	Per Cent.			
	V.	VI.	VII.	VIII.
Moisture at 100° C.,	4.94	4.41	12.33	8.20
Phosphoric acid,	1.54	1.28	1.54	1.87
Calcium oxide,	31.70	35.50	34.17	40.15
Potassium oxide,	4.80	4.76	4.39	4.70
Magnesium oxide,	4.58	4.87	3.26	4.42
Insoluble matter (before calcination),	20.85	9.64	15.37	20.55
Insoluble matter (after calcination),	18.57	6.10	12.19	18.33

Wood Ashes.

[I. Sent on by F. H. Williams, Sunderland, Mass. II. Sent on by C. H. Thompson & Co., Boston, Mass. III. and IV. Sent on from Amherst, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.31	2.57	8.67	19.14
Phosphoric acid,	1.65	1.53	1.25	1.72
Magnesium oxide,	2.41	5.29	2.88	3.04
Calcium oxide,	37.39	26.94	39.06	30.16
Potassium oxide,	7.78	7.95	5.38	4.76
Insoluble matter (before calcination),	10.93	17.44	17.42	21.76
Insoluble matter (after calcination),	6.15	15.66	8.79	13.45

Wood Ashes.

[I. Sent on by S. M. Farnsworth, Harvard, Mass. II. Sent on by J. J. H. Gregory, Marblehead, Mass. III. Sent on by D. G. Lang, Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	16.51	2.76	22.07
Phosphoric acid,	1.37	3.09	0.48
Magnesium oxide,	4.03	2.84	3.48
Calcium oxide,	32.54	32.03	29.11
Potassium oxide,	5.07	10.24	5.84
Insoluble matter (before calcination),	16.13	24.39	19.70
Insoluble matter (after calcination),	13.06	17.91	15.13

Cotton-seed Hull Ashes.

[I. Sent on from Hatfield, Mass. II. Sent on from Agawam, Mass. III. Sent on from South Deerfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	13.26	7.15	10.19
Phosphoric acid (6 cts. per lb.),	8.83	8.06	15.37
Potassium oxide (5½ cts. per lb.),	24.13	28.22	19.07
Calcium oxide,	8.92	10.50	5.14
Magnesium oxide,	8.60	15.25	9.78
Insoluble matter (before calcination),	14.29	12.75	18.11
Insoluble matter (after calcination),	12.22	10.57	12.16
Valuation per 2,000 lbs,	$37.14	$40.71	$39.42

The samples are of an exceptionally good quality.

Cotton-seed Hull Ashes.

[Sent on by Benj. M. Warner, Hatfield, Mass.]

	Per cent.
Moisture at 100° C.,	6.95
Phosphoric acid,	3.14
Potassium oxide,	25.10
Calcium oxide,	12.41
Magnesium oxide,	5.84
Insoluble matter (before calcination),	55.48
Insoluble matter (after calcination),	9.58

Potash Fertilizers.

[I. Muriate of Potash. II. Sulphate of Potash and Magnesia, sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	2.21	8.08
Potassium oxide,	49.77	21.88
Sodium oxide,	10.06	5.06
Calcium oxide,	2.07	3.54
Magnesium oxide,	0.45	11.93
Sulphuric acid,	0.55	43.43
Chlorine,	50.00	3.10
Insoluble matter,	0.17	0.77

Saltpetre Waste from Gunpowder Works.

[Sent on from Acton, Mass.]

	Per cent.
Moisture at 100° C,	5.19
Potassium oxide,	15.04
Sodium oxide,	36.82
Total calcium oxide,	.47
Total magnesium oxide,	.27
Nitrogen,	1.90
Sulphuric acid,	1.02
Total chlorine,	53.50
Calcium chloride,	.05
Magnesium chloride,	.63
Insoluble matter,	Trace.

The composition of this material varies in different samples in a marked degree. Its application on forage crops and on grass lands in particular has proved highly satisfactory.

Muck.

[I. and II. Sent on from Marlborough, Mass. III. Sent on from Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	33.64	40.63	56.46
Dry matter,	66.36	59.37	43.54
Nitrogen in dry matter,	1.65	1.21	1.16
Ash constituents in dry matter,	6.44	18.73	4.72
Insoluble matter in ash,	5.76	15.07	Not determined.

These samples are fair representatives of their kind. As the agricultural value of this material has been repeatedly discussed in previous reports, no further statement seems to be called for.

Muck.

[I. and II. Sent on by A. A. Rice, Mount Hermon, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	30.26	75.44
Dry matter,	69.74	24.56
Nitrogen,	2.54	.37
Ash constituents in dry matter,	8.28	12.00

Muck.

[Sent on by W. H. Earle, Worcester, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.030	11.231
Ash,	51.289	51.400
Ferric oxide,	Trace.	Trace.
Aluminic oxide,	6.672	6.953
Calcium oxide,	.038	.049
Magnesium oxide,	.030	.031
Potassium oxide,	.051	.062
Phosphoric acid,	.198	.232
Nitrogen,	1.470	1.460
Insoluble silicious matter,	39.755	39.635

Sea-weed.

[Sent on from Eastham, Mass., — two samples.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	12.05	14.96
Nitrogen ($16\frac{1}{2}$ cts. per lb.),	1.66	1.28
Phosphoric acid (6 cts. per lb.),	.44	.17
Potassium oxide ($4\frac{1}{4}$ cts. per lb.),	3.81	.36
Calcium oxide,	2.73	3.86
Magnesium oxide,	1.48	1.30
Sodium oxide,	11.75	8.40
Chlorine,	6.40	5.28
Insoluble matter,	7.73	.78
Valuation per 2,000 lbs.,	$9.25	$4.72

The samples were received in an air-dry state. According to statement, I. had been dried without any serious exposure to bad weather; II. had suffered from exposure for a considerable length of time.

Cotton-seed Meal (for manurial purposes).

[I. Sent on by Geo. Frost, Boston, Mass. II. and III Sent on by C. L. Warner, Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	6.26	8.30	8.30
Ash,	6.16	5.77	5.77
Calcium oxide,	.31	.31	.31
Magnesium oxide,	.95	.77	.77
Potassium oxide,	1.80	1.21	.89
Phosphoric acid,	1.32	1.45	1.26
Nitrogen,	7.26	6.69	6.88
Insoluble matter,	.53	.40	.40

Refuse Camel's Hair from Cotton-seed Oil Works.

[Sent on by W. H. Bowker, Boston, Mass.]

	Per cent.
Moisture at 100° C.,	8.80
Ash,	7.25
Nitrogen,	5.92
Potassium oxide,	2.56
Phosphoric acid,	2.77
Insoluble matter,	1.27

Castor Pomace.

[Sent on by Benj. M. Warner, Hatfield, Mass.]

	Per cent.
Moisture at 100° C.,	8.67
Ash,	5.70
Nitrogen,	5.72
Phosphoric acid,	1.57
Potassium oxide,	.97
Calcium oxide,	.71
Magnesium oxide,	.65
Insoluble matter,	1.21

Cotton Waste.

[Sent on by Samuel Pillsbury, Boston, Mass.]

	Per cent.
Moisture at 100° C.,	8.24
Nitrogen,	2.09
Phosphoric acid,	.83
Calcium oxide,	2.52
Magnesium oxide,	.66
Potassium oxide,	1.62
Insoluble matter,	20.10

Wool Waste.

[Sent on by A. S. Shepard, Franklin, Mass.]

	Per cent.
Moisture at 100° C.,	7.67
Ash,	10.63
Phosphoric acid,	1.15
Potassium oxide,	.54
Nitrogen,	5.26
Insoluble matter,	5.83

Waste from Cotton-seed Presses.

[Sent on by Oliver R. Robbins, Weston, Mass.]

	Per cent.
Moisture at 100° C.,	6.83
Ash,	23.47
Phosphoric acid,	.96
Potassium oxide,	.20
Nitrogen,	4.24
Insoluble matter,	17.74

Waste from Linseed Presses.

[Sent on by Oliver R. Robbins, Weston, Mass.]

	Per cent.
Moisture at 100° C.,	7.06
Ash,	2.34
Phosphoric acid,	2.43
Potassium oxide,	.24
Nitrogen,	8.05
Insoluble matter,	1.00

Scouring Liquor of Raw Wool.

[Sent on from Plymouth, Mass.]

	Per cent.
Moisture at 100° C.,	92.03
Dry matter,	7.97
Nitrogen (in liquid),	.09
Ash,	3.28
Calcium oxide,	.04
Magnesium oxide,	Trace.
Potassium oxide,	1.09
Sodium oxide,	.92
Iron and alumina oxides,	.09
Insoluble matter,	.22

One hundred parts of ash contained, —

	Per cent.
Calcium oxide,	1.22
Magnesium oxide,	Trace.
Potassium oxide,	33.23
Sodium oxide,	28.05
Iron and alumina oxides,	2.74
Insoluble matter,	6.91

The above-stated liquid was obtained, according to information received, by scouring raw wool with a solution of soda-ash and soap. The most noticeable constituent of the material is its comparatively large amount of potash (1.09 per cent.) in the calcined residue or ash. The presence of a liberal amount of potash compounds in raw wool is well known. A sample of raw wool from South America, tested here in that direction some years ago, showed from 3.92 to 4.2 per cent. of potassium oxide. The washings of sheep and of raw wool may be used with a good effect on grass lands. Solutions like the one above described are, however, too concentrated for direct use; they ought to be diluted with from ten to twenty times their weight of water, to render advisable their direct application on any growing vegetation.

Refuse Material from Soap Works.

[Sent on by Holyoke Soap Works, Holyoke, Mass.]

	Per cent.
Moisture at 100° C.,	19.70
Total phosphoric acid,	15.37
Soluble phosphoric acid,	.03
Reverted phosphoric acid,	5.29
Insoluble phosphoric acid,	10.05
Nitrogen,	4.24
Insoluble matter,	1.37

This material is similar to tankage in composition and in mechanical condition.

Fish Fertilizers.

[Sent on from Eastham, Mass. I. Salt Fish Waste. II. Fish Chum. III. Salt Fish Trimmings. IV. Whalebone. V. Whale Scrap.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	37.35	53.86	5.22	6.81	9.51
Total phosphoric acid,	2.89	3.80	5.50	20.84	1.15
Soluble phosphoric acid (8 cts. per lb.),	.58	.36	.69	.34	.84
Reverted phosphoric acid (7½ cts. per lb.),	1.16	1.77	2.15	1.84	.07
Insoluble phosphoric acid (3 cts. per lb.),	1.15	1.67	2 66	18.69	.24
Nitrogen (12 cts. per lb.),	5.26	4.26	7.63	3.40	9.64
Insoluble matter,	.10	.06	.26	3.69	9.10
Valuation per 2,000 lbs.,	$15.96	$14.46	$24.24	$22.67	$24.73

The main quantity of these substances was in a very coarse state.

Dry Ground Fish.

[I. and II. Sent on by R. P. Smith, Hatfield, Mass. III. Sent on by W. W Sanderson, South Deerfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	8.34	9.92	10.10
Ash,	37.76	28.37	21.50
Total phosphoric acid,	8.23	7.96	6.67
Soluble phosphoric acid,	.10	.61	.32
Reverted phosphoric acid,	3.81	3.79	.75
Insoluble phosphoric acid,	4.32	3.56	5.60
Nitrogen,	6.81	6.82	6.98
Insoluble matter,	82	1.34	4.57

Peruvian Guano.

[From P. Williams & Co., Taunton, Mass. I. Warranted Peruvian Guano, No. 1. II. Low-grade Peruvian Guano.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	14.18	16.14
Ash,	47.36	65.01
Total phosphoric acid,	19.91	22.26
Soluble phosphoric acid,	7.34	2.24
Reverted phosphoric acid,	6.05	5.03
Insoluble phosphoric acid,	6.52	14.99
Potassium oxide,	2.80	4.17
Nitrogen,	8.01	4.06
Insoluble matter,	4.04	7.83

Phosphatic Fertilizers.

[Sent on from Ashby, Mass. I. Acid Phosphate. II. Dissolved Bone-black. III. South Carolina Rock Phosphate.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	13.93	13.86	1.68
Total phosphoric acid,	13.84	16.37	25.81
Soluble phosphoric acid (8 cts. per lb.),	10.91	14.60	.27
Reverted phosphoric acid ($7\frac{1}{2}$ cts. per lb.),	.69	1.53	.47
Insoluble phosphoric acid (2 cts. per lb.),	2.24	.24	25.07
Insoluble matter,	9.54	2.09	11.64
Valuation per 2,000 lbs.,	$19.38	$25.80	$11.16

Bone-black.

[Sent on by F. G. Arnold, Swansea, Mass.]

	Per cent.
Moisture at 100° C.,	5.04
Ash,	67.43
Phosphoric acid,	16.56
Insoluble matter,	.37

Ground Bones.

[I., II. and III. Sent on from Amherst, Mass. IV. Sent on from Jamaica Plain, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	63.29	40.44	56.69	37.48
Fine medium, smaller than $\frac{1}{25}$ inch,	27.78	30.91	34.97	35.51
Medium, smaller than $\frac{1}{12}$ inch,	8.93	25.30	8.34	18.91
Coarser than $\frac{1}{12}$ inch,	–	3.35	–	8.10
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.12	11.24	6.31	6.92
Ash,	41.62	58.66	47.63	68.64
Total phosphoric acid,	24.13	20.85	19.72	22.59
Soluble phosphoric acid,	.17	4.87	1.16	.20
Reverted phosphoric acid,	9.12	1.20	9.34	6.65
Insoluble phosphoric acid,	14.75	14.78	9.22	15.74
Nitrogen,	3.60	2.85	6.84	4.82
Insoluble matter,	.55	.48	.71	3.23

Ground Bones.

[I. Sent on from Amherst, Mass. II. Sent on by A. S. Belcher, North Easton, Mass. III. Sent on by Edmund Hersey, Hingham, Mass. IV. Sent on by W. W. Sanderson, South Deerfield, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	22.59	18.53	34.79	59.00
Fine medium, smaller than $\frac{1}{25}$ inch,	18.71	10.14	21.22	24.09
Medium, smaller than $\frac{1}{12}$ inch,	24.61	7.12	14.71	12.32
Coarser than $\frac{1}{12}$ inch,	34.09	64.21	29.28	4.59
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	3.97	12.43	6.75	9.96
Ash,	49.35	64.21	61.35	55.83
Total phosphoric acid,	19.49	25.67	24.71	18.41
Soluble phosphoric acid,	–	.13	.09	2.73
Reverted phosphoric acid,	3.80	6.20	8.10	9.94
Insoluble phosphoric acid,	15.69	19.34	16.52	5.74
Nitrogen,	4.04	2.68	3.14	3.12
Insoluble matter,	.78	.42	.42	5.79

Phosphate Slag.

[I. German "Phosphate Slag," New York. II. "Phosphate Slag" sent on from England.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	5.08	.37
Ferric oxide and aluminum oxide,	15.98	8.55
Total phosphoric acid,	21.05	18.91
Calcium oxide,	53.97	49.22
Magnesium oxide,	3.83	Not determined.
Insoluble matter,	Not determined.	5.06

This material has been of late introduced into our markets in a fine-ground state as "phosphate meal," manufactured of the "Peine-Thomas Scoria." P. Weidinger, No. 76 Pine Street, New York City, who has advertised the sale of the above material for trial, makes the following statement: —

"We offer to the American fertilizer trade the article above stated, whose rapid and successful introduction into various countries, with constantly increasing demand, gives us a guarantee that its importance for agriculture will not be underrated. This is a very finely ground phosphate meal, obtained from the so-called 'Peine-Thomas Scoria,' through the dephosphorization of pig iron, after the patented method of Sidney Gilchrist Thomas. The dephosphorization of the iron takes place by melting the iron with lime in a current of air, a proceeding by which pig iron, rich in phosphorus, is converted into steel, free from phosphorus (ingot iron). In this manner the phosphorus of the pig iron is converted into phosphoric acid, which, uniting with the lime added, forms phosphate of lime. The melted mixture of phosphate of lime with excess of lime and combinations of the iron and manganese, obtained by this proceeding, is called 'Thomas Scoria.' It is brought into the market for the purposes of agriculture in a finely ground state."

The phosphoric acid present is neither to any extent soluble in water nor in a solution of citrate of ammonia. The composition of the slag is peculiar, on account of an excess of caustic lime, which favors a breaking up into minute particles when exposed to air and moisture. The more finely ground when exposed to atmospheric influences, the more rapidly takes place a general disintegration. This behavior tends to diffuse the phosphoric acid, and favors absorption by the roots. No previous treatment by acids has been found necessary to secure satisfactory returns when used as a phosphoric acid source for plant growth. On account of the alkaline reaction of the "phosphate meal," no ammonia salts or organic nitrogen compounds are used as an admixture for the production of more complete fertilizers. In case nitrogen shall be applied, nitrate of soda is used, to furnish that element. Muriate of potash and kainite are recommended as potash sources.

European agricultural chemists speak well of this new source of phosphoric acid. As it is claimed that phosphoric acid can be furnished at less cost and more efficiently in the form of "phosphate meal" than in any of our known mineral resources of insoluble phosphoric acid, it seems desirable that experiments should be instituted to test its merits.

Fifteen dollars per 2,000 pounds has been asked in our vicinity for a finely ground material.

Concentrated Flower Food.

[Sent on from Springfield, Mass.]

	Per cent.
Moisture at 100° C.,	11.20
Ash,	42.89
Phosphoric acid,	5.30
Sulphuric acid,	15.73
Potassium oxide,	4.72
Sodium oxide,	17.45
Calcium oxide,	6.18
Nitrogen in organic matter,	2.31
Nitrogen in nitrates,	4.66
Insoluble matter,	.25

Compound Fertilizers.

[I. Sent on by A. S. Hawley, North Hadley, Mass. II. Sent on by Staples & Phillips, Taunton, Mass. III. Sent on by C. M. Allen, Franklin, Mass. IV. Sent on by F. G. Arnold, Swansea, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.86	11.71	6.76	6.26
Ash,	48.44	57.84	52.96	56.88
Total phosphoric acid,	11.07	13.30	8.32	12.56
Soluble phosphoric acid,	5.87	5.80	2.86	2.09
Reverted phosphoric acid,	3.60	1.85	5.01	6.10
Insoluble phosphoric acid,	1.60	5.65	.45	4.37
Nitrogen in organic matter,	1.65	2.10	.19	3.78
Nitrogen in nitrate,	–		3.44	
Potassium oxide,	3.19	1.63	8.60	9.87
Insoluble matter,	5.50	6.01	1.52	3.03

Compound Fertilizers.

[I. Sent on by A. Bradley, Lee, Mass. II. Sent on by F. H. Bardwell, Hatfield, Mass. III. and IV. Sent on by Oscar L. Dorr, Sharon, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	12.43	12 34	10.50	19.47
Ash,	41.15	64.14	56.62	50.40
Total phosphoric acid,	8 90	12.33	12.86	8.32
Soluble phosphoric acid,	7.45	5.65	4.72	4.02
Reverted phosphoric acid,	1.06	3.22	5.25	2.02
Insoluble phosphoric acid,	.39	3.46	2.89	2.28
Potassium oxide,	7.28	1.34	5.00	2.54
Nitrogen,	4.73	1.52	3.80	3.28
Insoluble matter,	.94	6.56	1.61	10.19

Compound Fertilizers.

[I. Sent on by J. M. Aiken, Prescott, Mass. II. Sent on by W. W. Sanderson, South Deerfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.47	6.26
Ash,	54.21	62.53
Total phosphoric acid,	13.61	9.88
Soluble phosphoric acid,	3.91	3.97
Reverted phosphoric acid,	6.24	3.09
Insoluble phosphoric acid,	3.46	2.82
Potassium oxide,	1.45	3.54
Nitrogen,	2.48	1.38
Insoluble matter,	7.44	7.38

Compound Fertilizers.

[I. Sent on by Lawrence Hardware Co., Lawrence, Mass. II. Sent on by J. M. Aiken, Prescott, Mass. III. Sent on by A. Bradley, Lee, Mass. IV. Sent on by J. M. Aiken, Prescott, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.36	10.66	17.07	13.34
Ash,	59.19	60.64	44.24	49.38
Total phosphoric acid,	16.44	12.50	9.28	13.02
Soluble phosphoric acid,	4.03	5.50	7.47	6.81
Reverted phosphoric acid,	8.46	1.29	1.43	2.56
Insoluble phosphoric acid,	3.95	5.71	.38	3.65
Potassium oxide,	1.15	2.50	7.64	2.16
Nitrogen,	2.65	1.70	1.34	3.02
Insoluble matter,	3.43	8.09	1.69	5.07

VALUATION OF FERTILIZERS AND FERTILIZER ANALYSES.

The hitherto customary valuation of manurial substances is based on the average trade value of the fertilizing elements specified by analyses. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends in the majority of cases on the amount and the particular form of two or three essential articles of plant food, *i. e.*, phosphoric acid, nitrogen and potash, which they contain. The valuation which usually accompanies the analyses of these goods shall inform the consumer, as far as practicable, regarding the cash retail price at which the several specified essential elements of plant food, in an efficient form, have been offered of late for sale in our large markets.

The market value of low-priced materials used for manurial purposes, such as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse, and waste materials of different descriptions, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The market price of manurial substances is liable to serious fluctuations; for supply and demand exert here, as well as in other branches of commercial industry, a controlling influence on their temporary money value. As farmers in many instances have but little chance to obtain the desired information, agricultural chemists charged with the inspection of commercial fertilizers assist in the work, by ascertaining as far as practicable the actual market price of the leading

manurial substances in our principal markets for a given period of time. The results of the inquiries into the condi tion of the trade during the six months preceding the 1st of March, 1888, are embodied in the subsequent tabular statement of cost of fertilizing ingredients for the opening of the season of 1888.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultation with leading manufacturers of fertilizers, and notes on actual sales of individual farmers and farmers' associations, etc., furnish the necessary information regarding the current trade value of fertilizing ingredients. The subsequent statement of cash values in the retail trade is obtained by taking the average of the wholesale quotations in New York and Boston, during the six months preceding March 1, 1888, and increasing them by twenty per cent., to cover expenses of sales, credits, etc.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.

	1888. Cents per Pound.
Nitrogen in ammoniates,	17½
Nitrogen in nitrates,	16
Organic nitrogen in dry and fine-ground fish, meat, blood, cotton-seed meal and castor pomace,	16½
Organic nitrogen in fine-ground bone and tankage,	16½
Organic nitrogen in fine-ground medium bone and tankage,	13
Organic nitrogen in medium bone and tankage,	10½
Organic nitrogen in coarser bone and tankage,	8½
Organic nitrogen in hair, horn-shavings and coarse fish scrap,	8
Phosphoric acid soluble in water,	8
Phosphoric acid soluble in ammonium citrate,*	7½
Phosphoric acid in dry-ground bone, fish bone and tankage,	7
Phosphoric acid in fine medium bone and tankage,	6
Phosphoric acid in medium bone and tankage,	5
Phosphoric acid in coarser bone and tankage,	4
Phosphoric acid in fine-ground rock phosphate,	2
Potash as high-grade sulphate, and in forms free from muriate and chlorides,	5½
Potash as kainite,	4¼
Potash as muriate,	4¼

* Dissolved from two grams of phosphate unground, by 100 C. C. neutral solution of ammonium citrate, sp. gr. 1.09 in thirty minutes at 65° C., with agitation once in five minutes; commonly called "reverted" or "back-gone" phosphoric acid.

The above trade values are the figures at which, in the six months preceding March 1, the respective ingredients could be bought at retail for cash in our large markets, in the raw materials which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the reasonable retail price at the large markets of standard raw materials, such as —

Sulphate of ammonia,	Dried ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

To obtain the valuation of a fertilizer (*i. e.*, the money worth of its fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substances. Two samples of fish fertilizer, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers and refuse materials of various descriptions, sent to the Station for examination, are valued with reference to the market prices of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

A large percentage of commercial fertilizing material consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industry is liable to affect at any time, more or less seriously, the composition of the refuse. A constant inquiry into the character of the agricultural chemicals, and of commercial manurial refuse substances offered for sale, cannot fail to secure confidence in their composition, and to diminish financial disappointment in consequence of their application. This work is carried on for the purpose of aiding the farming community in a clear and intelligent appreciation of these substances for manurial purposes.

Consumers of commercial manurial substances do well to buy, whenever practical, on guaranty of composition with reference to their essential constituents, and see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Analyses of Water sent on for Examination.

[Parts per Million.]

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
I., ...	.108	.160	17.80	148.00	60.00	4.03	-	No. Amherst.
II., ...	.01	.06	7.00	104.00	56.00	4.57	None.	Amherst.
III., . . .	.23	.34	47.00	312.00	206.00	9.14	None.	Amherst.
IV., . . .	.25	.44	19.00	202.00	68.00	2.86	Present.	Littleton.
V., ...	.09	.10	6.00	132 00	72.00	3.25	None.	No. Amherst.
VI., . . .	.40	.12	137.20	546.00	124.00	-	-	Amherst.
VII., . .	.03	.05	6.00	64.00	46.00	1.56	None.	Ipswich.
VIII., .	SO_3 — CaO —	82.00 63.00	64.00	310.00	100.00	9.57	-	Ashby.
IX., . . .	.12	.09	None	38.00	30.00	.63	-	Ashby.
X., ...	.08	.08	42.00	300.00	76.00	7.00	-	Ashby.
XI., . . .	.17	.05	20 00	192.00	104.00	3.12	None.	No. Amherst.
XII., . .	.07	.02	9.00	138.00	60.00	2.86	None.	Ashby.
XIII., . .	None	.02	20.00	178.00	70.00	1.82	None.	Ashby.
XIV., . .	.44	.28	22.00	160.00	40.00	3.12	None.	Ashby.
XV., . .	.05	.18	144.00	530.00	102.00	5.43	None.	Ashby.
XVI., . .	.13	.46	None	70.00	36.00	1.43	-	Amherst.
XVII., . .	.08	.08	42.00	354.00	108.00	5.29	None.	Amherst.
XVIII., . .	.12	.28	6.00	86.00	26.00	1.43	None.	East Amherst.
XIX., . .	.05	.44	20.00	146.00	52.00	4.57	None.	East Amherst.
XX., . .	None	.04	9.00	72.00	24.00	1.27	None.	East Amherst.
XXI., . .	.26	.24	20.00	124.00	46.00	1.11	None.	Boston.
XXII., . .	.10	.10	9.10	72.00	52.00	1.11	None.	Boston.
XXIII., . .	.64	.36	45 00	268.00	96.00	8.43	-	Sherborn.
XXIV., . .	None	.06	12.00	106.00	56.00	2.21	None.	Wellesley.
XXV., . .	None	.09	25.04	318.00	76.00	7.86	Present.	No. Hadley.
XXVI., . .	-	-	-	-	-	-	None.	No. Hadley.
XXVII., . .	.066	.14	18.00	208.00	96.00	5.00	-	No. Amherst.
XXVIII., .	3.33	.80	127.00	720.00	224.00	10.00	None.	No. Hadley.
XXIX., . .	Trace	.06	Trace	38.00	30.00	1.69	None.	No. Hadley.
XXX., . .	None	.06	31.00	196.00	76.00	3.51	None.	Shirley.
XXXI., . .	1.30	.40	47.40	7.14	380.00	98.00	None.	Shirley.
XXXII., . .	.08	.06	8.00	98.00	22.00	2.60	None.	No. Amherst.
XXXIII., .	4.70	1.50	125.00	844.00	182.00	10.10	-	No. Hadley.
XXXIV., .	.12	.20	None	40.00	24.00	-	-	Amherst.
XXXV., . .	.09	.09	Trace	68.00	28.00	-	-	Amherst.
XXXVI., .	.12	.05	3.00	68.00	26.00	2.21	None.	Amherst.

ANALYSES OF WATER — *Continued.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
XXXVII., .	.02	.04	None	38.00	22.00	-	-	Worthington.
XXXVIII., .	.01	.05	None	52.00	30.00	.79	-	Worthington.
XXXIX., .	Trace	.02	None	22.00	14.00	1.43	-	Worthington.
XL., . .	1.15	.05	28.00	306.00	82.00	7.86	-	Amherst.
XLI., . .	.02	.14	None	24.00	12.00	-	-	Worthington.
XLII., . .	Trace	.02	Trace	54.00	40.00	.95	-	Worthington.
XLIII., . .	.04	.03	None	52.00	36.00	2.08	-	Worthington.
XLIV., . .	-	-	-	-	-	-	Present.	East Amherst.
XLV., . .	-	-	-	-	-	-	None.	East Amherst.
XLVI., . .	-	-	-	-	-	-	None.	Amherst.
XLVII., . .	-	-	-	-	-	-	None.	Berlin.
XLVIII., .	Trace	.05	None	22.00	2.00	-	-	Worthington.
XLIX., . .	.12	.12	None	148.00	64.00	1.56	None.	No. Hadley.
L., . . .	.14	.58	.60	74.00	34.00	3.12	None.	Westhampton.
LI., . . .	.05	.20	5.00	86.00	54.00	2.34	None.	Wellesley.
LII., . .	.10	.14	Trace	238.00	114.00	7.00	-	So. Hadley.
LIII., . .	.01	.10	23.00	154.00	50.00	2.86	-	Ashby.
LIV., . .	1.40	7.90	4.00	422.00	322.00	17.06	None.	Amherst.
LV., . . .	1.50	.70	126.00	482.00	198.00	8.29	None.	Amherst.
LVI., . .	.40	.55	8.00	142.00	58.00	3.90	None.	Amherst.
LVII., . .	.01	.016	2.00	148.00	64.00	4.71	Present.	Amherst.
LVIII., . .	.02	.05	18.00	148 00	40.00	4.86	None.	Amherst.
LIX., . .	.04	.05	11.00	52.00	16.00	1.95	None.	Amherst.
LX., . .	.05	.05	9.00	20.00	8.00	1.56	None.	Amherst.
LXI., . .	.03	.04	13.00	116.00	60 00	2.86	None.	Amherst.
LXII., . .	.01	.07	34.00	292.00	156.00	5.86	None.	Amherst.
LXIII., . .	.03	.10	6.00	216.00	44.00	5.00	None.	Amherst.
LXIV., . .	.03	.16	Trace	88.00	48.00	.32	None.	Amherst.
LXV., . .	1.36	1.20	57.00	412.00	108.00	8.14	-	Amherst.
LXVI., . .	.003	.04	24.00	120.00	56.00	6.29	-	Amherst.
LXVII., . .	.016	.044	3.00	140.00	70.00	.63	None.	No. Dana.
LXVIII., .	.45	.35	8.00	52.00	20.00	1.56	None.	No. Amherst.
LXIX., . .	.06	.10	22.00	116.00	26 00	2.21	None.	Amherst.
LXX., . .	.026	.08	38.00	324.00	160.00	8.29	None.	Amherst.
LXXI., . .	.024	.044	22.00	308.00	64 00	5.14	None.	Amherst.
LXXII., . .	.124	.148	2.00	56.00	12.00	1.11	None.	Amherst.
LXXIII., .	-	.05	Trace	45.00	35.00	1.56	None.	Littleton.

ANALYSES OF WATER — *Concluded.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
LXXIV., .	.06	.05	53.00	325.00	177.00	7.43	None.	Northampton.
LXXV., . .	Trace	.04	25.00	212.00	112.00	4.86	-	Amherst.
LXXVI., .	.04	.06	19.00	92.00	40.00	.95	-	Amherst.
LXXVII., .	.07	.05	Trace	62.00	42.00	.79	None.	Amherst.
LXXVIII., .	.04	.22	Trace	34.00	4.00	-	-	Amherst.
LXXIX., .	.01	.04	3.00	68.00	22.00	1.56	None.	Amherst.
LXXX., . .	.02	.07	5.00	40.00	10.00	1.11	None.	Amherst.
LXXXI., .	.03	.08	12.00	112.00	51.00	2.99	None.	Framingham.
LXXXII., .	Trace	.18	13.00	153.00	94.00	3.25	None.	Amherst.
LXXXIII., .	.03	.10	Trace	70.00	45 00	1.11	None.	Sunderland.
LXXXIV., .	.04	.03	Trace	45.00	30.00	-	None.	Northampton.
LXXXV., .	.04	.07	15.00	111.00	70.00	3 79	None.	Northampton.

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the indications of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

* One gallon equals 70,000 grains.

5. Albuminoid ammonia over .15 parts per million ought to absolutely condemn the water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the above results of analyses shows that Nos. 5, 9, 10, 11, 17, 22, 27, 35, 36, 64, 78 and 82 are of a suspicious character, and that Nos. 1, 3, 4, 6, 14, 15, 16, 18, 19, 21, 23, 28, 31, 33, 34, 40, 49, 50, 51, 52, 54, 55, 56, 64, 65, 68 and 72 ought to be condemned, on account of a large amount of free and albuminoid ammonia, due most likely to access of sewage water. An examination of the above statement shows that a large proportion of the samples received were from bad wells. Of fifty-eight samples of water tested for lead, four were found to be poisoned by that metal, in consequence of the use of lead pipes.

A satisfactory supply of good drinking water on a farm depends, in a controlling degree, on a judicious selection of the location of the well designed for the use of the family and for the live stock, and on the personal attention bestowed, from time to time, on the condition of the well and its surroundings. Good wells are liable to change for the worst at any time, on account of circumstances too numerous to state in this connection. To ascertain, from time to time, the exact condition of the water which supplies the wants of the family and of the live stock, is a task which no farmer can, for any length of time, neglect, without incurring a serious risk to health and prosperity.

The subject receives, quite frequently, but little attention, on account of the fact that the harmful qualities which an apparently good water may contain are disguised beyond recognition by the unaided senses. Certain delicate chemical tests, aided at times by microscopic observations, are, in the majority of cases, the only reliable means, in our present state of scientific inquiry, by which desirable information regarding the true character of a drinking water can be obtained.

Parties sending on water for an analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.*

Prepared by Mr. W. H. Beal.

As the basis of valuation changes from year to year, no valuation is stated.

1868 to 1889

Muriate of Potash (45 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	4.05	.05	2.05
Potassium oxide,	58.98	45.94	52.46
Sodium oxide,	11.26	2.13	6.69
Magnesium oxide,	.90	.30	.55
Chlorine,	54.00	43.20	48.60
Insoluble matter,	2.00	.15	.75

Sulphate of Potash (15 Analyses).

	Highest.	Lowest.	Average.
Moisture at 100° C.,	5.00	.19	1.00
Potassium oxide,	51.28	20.44	35.86
Sodium oxide,	8.59	.34	4.46
Magnesium oxide,	2.63	.24	1.50
Sulphuric acid,	59.30	10.86	45.00
Insoluble matter,	31.55	.14	.75

* This compilation does not include the analyses made of licensed fertilizers. They are to be found in the Reports of the State Inspector of Fertilizers from 1873 to 1889, contained in the Reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

Sulphate of Potash and Magnesia (13 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	11.58	1.95	5.50
Potassium oxide,	27.77	11.70	22.50
Sodium oxide,	18.97	2.09	6.50
Magnesium oxide,	13.66	10.86	12.25
Calcium oxide,	3.38	.82	2.50
Sulphuric acid,	47.90	31.91	43.00
Chlorine,	7.80	.14	2.50
Insoluble matter,	2.36	.26	1.41

German Potash Salts (11 Analyses).

Moisture at 100° C.,	25.83	.45	13.14
Potassium oxide,	50.40	7.56	21.63
Sodium oxide,	26.23	1.30	13.76
Calcium oxide,	1.26	.06	.85
Magnesium oxide,	9.83	Trace.	9.25
Sulphuric acid,	21.53	.17	10.85
Chlorine,	49.11	22.27	35.63
Insoluble matter,	3.76	.90	2.08

Kainite (3 Analyses).

Moisture at 100° C.,	13.57	2.15	9.26
Potassium oxide,	16.48	12.51	14.04
Sodium oxide,	–	–	21.38
Calcium oxide,	1.41	.82	1.12
Magnesium oxide,	11.30	6.65	8.97
Sulphuric acid,	23.71	17.53	21.05
Chlorine,	–	–	32.38
Insoluble matter,	1.56	.17	.86

Carnallite (1 Analysis).

	Per cent.
Potassium oxide,	13.68
Sodium oxide,	7.66
Magnesium oxide,	13.19
Sulphuric acid,	.56
Chlorine,	41.56

Krugite (1 Analysis).

	Per cent.
Moisture at 100° C.,	4.82
Calcium oxide,	12.45
Magnesium oxide,	8.79
Potassium oxide,	8.42
Sodium oxide,	5.57
Sulphuric acid,	31.94
Chlorine,	6.63
Insoluble matter,	14.96

Sulphate of Magnesia (9 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	31.90	7.50	22.50
Calcium oxide,	3.89	1.15	2.52
Magnesium oxide,	25.29*	13.50	18.25
Sulphuric acid,	52.23*	31.91	37.00
Insoluble matter,	11.06	.40	5.73

* Kieserite, natural and calcined.

Nova Scotia Plaster (9 Analyses).

Moisture at 100° C.,	15.79	.52	6.50
Calcium oxide,	37.59	30.60	33.50
Magnesium oxide,	1.40	.36	.75
Sulphuric acid,	54.10	33.56	44.00
Insoluble matter,	7.95	.45	2.00

Onondaga Plaster * (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average
Moisture at 100° C.,	22.25	8.95	13.27
Calcium oxide,	31.46	29.15	30.00
Magnesium oxide,	6.06	3.89	4.66
Sulphuric acid,	36.00	31.58	33.00
Carbonic acid,	8.80	7.20	8.20
Insoluble matter,	12.00	8.28	9.83

* Contains 1 sample of Cayuga plaster.

Gypseous Shale (1 Analysis).

	Per cent.
Calcium sulphate.	38.55
Calcium carbonate,	11.05
Magnesium carbonate,	2.65
Insoluble matter,	37.15

Gas-house Lime (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	33.55	11.01	22.28
Calcium oxide,	45.80	40.00	42.66
Magnesium oxide,	8.30	8.30	8.30
Sulphuric acid,*	20.73	20.73	20.73
Insoluble matter,	15.00	.40	6.05

* Sulphuric acid includes all forms of sulphur present.

Lime Waste.

	Per Cent.		
	Liquid from Lime-vats (evaporated).	Mass from bottom of Lime-vats.	Lime waste from Sugar Factory.
Moisture at 100° C.,	11.50	17.54	36.30
Ash,	41.00	65.24	–
Calcium oxide,	23.40	47.80	27.51
Magnesium oxide,	–	–	Trace.
Potassium oxide,	–	–	.22
Phosphoric acid,	.77	.81	2.25
Nitrogen,	6.87	1.06	–
Insoluble matter,	.10	5.50	.32

Lime-kiln Ashes (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	30.70	.20	15.45
Calcium oxide,	50.16	36.00	43.08
Magnesium oxide,	4.45	1.26	2.60
Potassium oxide,	1.70	.02	.86
Phosphoric acid,	3.16	Trace.	1.18
Carbonic acid,	39.36	9.66	16.66
Insoluble matter,	53.77	3.30	14.54

Marls * (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	55.80	.60	18.18
Calcium oxide,	50.61	20.72	40.07
Magnesium oxide,	1.03	.22	.64
Iron and alumina,	1.00	.36	.69
Phosphoric acid,	2.72	.07	1.05
Carbonic acid,	40.38	16.63	28.51
Insoluble matter,	3.44	3.44	3.44

* Massachusetts.

Virginia Marl.

	Per Cent.	
	2 feet below Surface.*	4 feet below Surface.†
Moisture at 100° C.,	16.70	15.26
Calcium oxide,	9.21	5.29
Magnesium oxide,	.25	.16
Potassium oxide,	.61	.37
Phosphoric acid,	.09	.08
Sulphuric acid,	1.00	.31
Carbonic acid,	4.23	1.76
Insoluble matter,	59.59	68.86

* No. 1 contained a large amount of shells. † No. 2 was largely sand.

Wood Ashes. (Canada.) (87 Analyses.)

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	28.57	.70	12.00
Calcium oxide,	50.89	18.00	34.44
Magnesium oxide,	7.47	2.28	3.50
Iron oxide,	–	–	.83
Potassium oxide,	10.24	2.49	5.50
Phosphoric acid,	3.99	.29	1.85
Insoluble matter,	24.10	2.10	12.50

Cotton-seed Hull Ashes (23 Analyses).

Moisture at 100° C.,	26.81	2.30	7.33
Calcium oxide,	39.75	3.35	10.00
Magnesium oxide,	17.15	2.02	9.50
Iron oxide,	–	–	1.50
Potassium oxide,	42.12	5.00	20.95
Phosphoric acid,	13.67	.76	7.52
Insoluble matter,	32.48	5.38	11.79

Ashes of Spent Tan-bark (3 Analyses).

Moisture at 100° C.,	7.45	4.87	6.31
Calcium oxide,	37.26	31.35	33.46
Magnesium oxide,	5.10	2.57	3.55
Potassium oxide,	2.87	1.14	2.04
Phosphoric acid,	2.77	.13	1.61
Insoluble matter,	24.33	24.33	24.33

Ashes of Waste Products.

	Per Cent.		
	Chestnut R. R. Ties.	Logwood.	Mill.
Moisture at 100° C.,	6.15	1.50	.53
Calcium oxide,	4.71	3.90	34.93
Magnesium oxide,	1.80	Trace.	1.35
Potassium oxide,	.19	.08	1.60
Phosphoric acid,	1.54	2.30	.46
Insoluble matter,	77.83	9.70	36.36

Hard Pine Wood Ashes.

	Per cent.
Moisture at 100° C.,	.75
Calcium oxide,	24.95
Magnesium oxide,	8.39
Potassium oxide,	10.16
Phosphoric acid,	2.24
Insoluble matter,	29.90

Nitrate of Potash (2 Analyses).

	Per cent.	
Moisture at 100° C.,	1.75	2.10
Potassium oxide,	44.76	45.62
Nitrogen,	11.60	14.58
Insoluble matter,	Trace.	

Nitrate of Soda (13 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	2.00	.85	1.25
Sodium oxide,	70.97	35.00	35.50
Calcium oxide,	.41	Trace.	Trace.
Magnesium oxide,	.04	Trace.	Trace.
Nitrogen,	16.26	14.44	15.75
Sulphuric acid,	.20	Trace.	Trace.
Chlorine,	2.52	.20	.50
Insoluble matter,	.90	.24	.50

Saltpetre Waste from Gunpowder Works (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	4.24	.50	2.75
Potassium oxide,	30.94	4.65	18.00
Sodium oxide,	45.92	22.08	34.00
Calcium oxide,	.83*	.71*	.75
Magnesium oxide,	.28*	.09*	.19
Nitrogen,	3.30	.80	2.43
Sulphuric acid,	4.85*	.84*	2.85
Chlorine,	56.00	37.66	48.30

* Only estimations reported.

Nitre Salt-cake (2 Analyses).

Moisture at 100° C.,	6.71	5.34	6.03
Potassium oxide,	.87	Trace.	.87
Sodium oxide,	32.72	26.40	29.56
Nitrogen,	2.29	–	2.29
Sulphuric acid,	48.85	46.69	47.77
Insoluble matter,	4.12	3.73	3.92

Sulphate of Ammonia (22 Analyses).

Moisture at 100° C.,	2.40	.13	1.00
Nitrogen,	22.23	19 70	20.50
Sulphuric acid,	70.70	57.68	60.00
Insoluble matter,	–	–	Trace.

Ammonite.

	Per cent.
Moisture at 100° C.,	5.88
Phosphoric acid,	3.43
Nitrogen,	11.33
Insoluble matter,	1.38

Dried Blood (11 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	21.52	7.65	12.50
Ash,	10.04	3.56	6 37
Phosphoric acid,	6.23	1.53	1.91
Nitrogen,	13.55	7.80	10.52

Refuse Materials (Animal).

	Per Cent.		
	Oleomargarine Refuse.	Felt Refuse.	Sponge Refuse.
Moisture at 100° C.,	8.54	39.24	7.25
Ash,	14.42	33.53	–
Calcium oxide,	–	–	3.94
Magnesium oxide,	–	–	1.27
Phosphoric acid,	.88	–	3.19
Nitrogen,	12.12	5.26	2.43
Insoluble matter,	.96	8.44	39.05

Horn and Hoof Waste (3 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.27	10.08	10.17
Ash,	14.62	1.05	7.63
Phosphoric acid,	–	–	2.30
Nitrogen,	16.10	11.84	14.47
Insoluble matter,	–	–	.24

Wool Waste (3 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.12	8.43	9.27
Nitrogen,	6.25*	5.00	5.62

* Saturated with oil.

Raw Wool and Wool Washings.

	Per Cent.			
	Raw Wool.	Water Washings.	Acid Washings.	Liquid from Wool Washings.
Moisture at 100° C.,	6.95	–	–	92.03
Ash,	7.54	–	–	3.28
Fat,	3.92	–	–	–
Calcium oxide,	–	.28	.61	.04
Magnesium oxide,	–	None.	.20	Trace.
Potassium oxide,	–	3.92	4.20	1.09
Sodium oxide,	–	.49	.40	.92
Nitrogen,	12.88	–	–	.09
Insoluble matter,	3.63	–	–	.22

Meat Mass (6 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	18.75	8.16	12.09
Ash,	14.66	2.90	13.60
Total phosphoric acid,	3.58	.56	2.07
Nitrogen,	11.50	9.69	10.44
Insoluble matter,	.77	.40	.58

Refuse from Rendering Establishments.

	Per Cent.					
	Bone Soup.	Dried Soup from Meat and Bone.	Dried Soup from Rendering Cattle Feet.	Soup from Horse Rendering Factory.	Soap Grease Refuse. I.	Soap Grease Refuse. II.
Moisture at 100° C.,	82.92	14.80	10.80	92.14	38.79	19.70
Ash,	7.07	8.40	7.50	–	43.13	59.65
Phosphoric acid,	1.26	.53	.46	.14	11.04	15.37
Nitrogen,	1.14	9.97	14.47	1.12	2.21	4.20
Insoluble matter,	–	.64	.26	–	1.20	1.37

Bones (103 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	11.90	3.05	7.47
Ash,	74.90	37.25	56.07
Total phosphoric acid,	29.83	12.06	22.50
Soluble phosphoric acid,	.76	.10	.43
Reverted phosphoric acid,	16.78	2.24	6.50
Insoluble phosphoric acid,	23.37	8.13	15.70
Nitrogen,	6.75	1.50	4.12
Insoluble matter,	6.00	.04	2.00

Tankage (12 Analyses).

Moisture at 100° C.,	28.09	5.46	14.61
Ash,	37.06	19.40	23.23
Total phosphoric acid,	14.60	8.00	10.67
Soluble phosphoric acid,	.27	.27	.27
Reverted phosphoric acid,	–	–	3.25
Insoluble phosphoric acid,	–	–	8.79
Nitrogen,	8.07	5.82	7.08
Insoluble matter,	2.00	.56	1.23

Fish containing 20 per cent. or less of Moisture (47 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	19.88	6.61	13.24
Ash,	72.23	15.99	20.00
Total phosphoric acid,	16.64	4.33	8.25
Soluble phosphoric acid,	1.70	.37	.55
Reverted phosphoric acid,	4.57	1.78	2.17
Insoluble phosphoric acid,	7.16	2.11	3.80
Potassium oxide,	.45	.45	.45
Nitrogen,	10.24	3.87	7.05
Insoluble matter,	4.99	.74	2.50

Fish containing between 20 per cent. and 40 per cent. of Moisture (8 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	38.11	20.58	29.34
Ash,	36.50	16.87	24.14
Total phosphoric acid,	8.90	5.60	7.25
Soluble phosphoric acid,	–	–	.82*
Reverted phosphoric acid,	–	–	2.87*
Insoluble phosphoric acid,	–	–	3.99*
Potassium oxide,	–	–	.85†
Nitrogen,	7.41	4.22	5.81
Insoluble matter,	2.89	.82	1.85

* Fish pomace. † Dry ground fish.

Fish containing 40 per cent. and more of Moisture (12 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	50.58	40.35	45.46
Ash,	20.78	1.92*	12.50
Total phosphoric acid,	8.56	1.02*	5.08
Soluble phosphoric acid,	1.51	.83	1.17
Reverted phosphoric acid,	2.02	.64	1.33
Insoluble phosphoric acid,	3.62	1.88	2.75
Nitrogen,	7.60	2.43	4.97
Insoluble matter,	2.44	.16	1.35

* Fish-liver refuse.

Whale Flesh.

	Per Cent.			
	Raw.	Dry (with Fat).	Dry (without Fat).	Whale Scrap.
Moisture at 100° C.,	44.50	–	–	9.51
Ash,	1.04	1.86	3 20	11.74
Fat,	22.81	40.70	–	–
Flesh,	32.10	57.44	96.80	–
Nitrogen,	4.86	8.68	14.60	9.64

Lobster Shells.

	Per cent.
Moisture at 100° C.,	7.27
Calcium oxide,	22.24
Magnesium oxide,	1.30
Phosphoric acid,	3.52
Nitrogen,	4.50
Insoluble matter,	.27

Peruvian Guano (26 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	22.61	7.02	14.81
Ash,	61.65	13.58	37.61
Total phosphoric acid,	23.10	3.43	13.26
Soluble phosphoric acid,	8.80	.35	4.57
Reverted phosphoric acid,	6.20	1.38	3.79
Insoluble phosphoric acid,	16.50	4.67	10.58
Potassium oxide,	4.08	1.14	2.61
Nitrogen,	11.26	4.44	7.85
Insoluble matter,	11.91	1.30	6.60

Bat Guano (9 Analyses).

[One sample contained 1.31 per cent. potassium oxide.]

Moisture at 100° C.,	72.38	7.80	40.09
Ash,	72.14	4.34	38.24
Phosphoric acid,	6.53	1.00	3 76
Nitrogen as nitrates,	1.80	.24	1.02
Nitrogen as ammoniates,	3.42	1.49	2.45
Nitrogen in organic matter,	5.66	.34	3.00
Insoluble matter,	54.15	.20	2.00

Cuba Guano (7 Analyses).

Moisture at 100° C.,	36.85	12.10	24.27
Potassium oxide,	1.20	.14	.67
Phosphoric acid,	24.35	11.54	17.94
Nitrogen as nitrates,	1.00	.24	.62
Nitrogen as ammoniates,	.26	.14	.20
Nitrogen in organic matter,	1.48	.23	.85
Insoluble matter,	3.40	2.95	3.17

Caribbean Guano (Orchilla) (10 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	12.50	2.12	7.31
Calcium oxide,	45.00	34.91	39.95
Magnesium oxide,	4.13	2.46	3 29
Phosphoric acid,	35.43	18.11	26.77
Sulphuric acid,	2.36	1.80	2.08
Insoluble matter,	2.40	.17	1.27

South American Bone Ash.

	Per cent.
Moisture at 100° C.,	7.00
Calcium oxide,	44.89
Phosphoric acid,	35.89
Insoluble matter,	4.50

South Carolina Rock Phosphate (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	1.90	.10	1.50
Calcium oxide,	–	–	41.87*
Magnesium oxide,	–	–	3.03*
Iron and alumina oxide,	–	–	4.26*
Total phosphoric acid,	30.51	25.81	28.03
Soluble phosphoric acid,	–	–	.27*
Reverted phosphoric acid,	.47	.19	.33
Insoluble phosphoric acid,	30.31	25.07	27.69
Insoluble matter,	13.74	9.18	11.61

* Only estimate.

Navassa Phosphate (2 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	–	–	5.60*
Calcium oxide,	37.67	37.22	37.44
Iron oxide,	11.79	8.75	10.27
Alumina oxide,	–	–	4.24*
Phosphoric acid,	34.45	34.09	34.27
Insoluble matter,	–	–	2 70*

* Only one test.

Brockville Phosphate (1 Analysis).

	Per cent.
Moisture at 100° C.,	2 50
Phosphoric acid,	35.21
Insoluble matter,	6.46

Bone-black (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.65	1.55	4.60
Phosphoric acid,	30.54	23.47	28.28
Insoluble matter,	6.60	1.53	3.64

Phosphatic Slags.

[I. German phosphatic slag. II. English slag.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.10	.37
Calcium oxide,	41.87	49.82
Magnesium oxide,	3.03	–
Iron and alumina oxides,	4.26	–
Total phosphoric acid,	30.51	18.91
Soluble phosphoric acid,	–	–
Reverted phosphoric acid,	.19	5.93
Insoluble phosphoric acid,	30.32	12.98
Insoluble matter,	13.74	5.06

Castor Bean Pomace (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100 C.,	10.18	9.25	9.98
Calcium oxide,	.96	.77	.87
Magnesium oxide,	.37	.20	.29
Potassium oxide,	1.70	.64	1.12
Phosphoric acid,	2.22	2.03	2.16
Nitrogen,	5.72	5.33	5.56
Insoluble matter,	2.38	1.12	1.75

Cotton Refuse.

	Per Cent.			
	Cotton Dust.	Cotton Waste (Dry).	Cotton Waste (Wet).	Cotton Waste.
Moisture at 100° C.,	34.46	5.53	34.69	8.24
Ash,	50.93	–	–	–
Calcium oxide,	.90	1.45	2.45	2.52
Magnesium oxide,	.90	.87	1.13	.66
Potassium oxide,	.19	.89	.80	1.62
Phosphoric acid,	.21	.84	1.54	.83
Nitrogen,	.50	1.32	1.30	2.09
Insoluble matter,	47.46	49.68	41.33	20.10

Cotton-seed Meal (6 Analyses).

[I. Average of five analyses. II. Damaged.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	6.80	9.90
Ash,	5.77	–
Calcium oxide,	.39	.22
Magnesium oxide,	.99	.56
Potassium oxide,	.89	1.21
Phosphoric acid,	1.45	1.26
Nitrogen,	6.10	3.73
Insoluble matter,	.60	.20

Rotten Brewer's Grain.

	Per cent.
Moisture at 100° C.,	78.77
Calcium oxide,	.26
Magnesium oxide,	.15
Potassium oxide,	.04
Phosphoric acid,	.43
Nitrogen,	.72
Insoluble matter,	.59

Tobacco Stems (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	12.18	8.95	10.61
Ash,	15.00	13.30	14.07
Calcium oxide,	4.76	3.39	3.89
Magnesium oxide,	1.40	1.11	1.23
Potassium oxide,	8.82	3.34	6.44
Sodium oxide,	.68	.16	.34
Phosphoric acid,	.87	.44	.60
Nitrogen,	2.69	.90	2.29
Insoluble matter,	1.35	.29	.82

Refuse Materials (Vegetable).

	PER CENT.		
	Glucose Refuse.	Hop Refuse.	Sumac Waste.
Moisture at 100° C.,	8.10	8.98	63.06
Ash,	–	–	6.80
Calcium oxide,	.18	.27	1.14
Magnesium oxide,	.02	.10	3.25
Potassium oxide,	.15	.11	.17
Phosphoric acid,	.29	.20	–
Nitrogen,	2.62	.98	1.19
Insoluble matter,	.07	.63	2.25

Sea-weed.

	PER CENT.				
	EEL-GRASS.		ROCKWEED.		Wet Kelp.
	I.	II.	Green.	Dry.	
Moisture at 100° C.,	45.61	25.17	68.50	10.68	88.04
Ash,	20.39	10.81	23.70	55.75	2.26
Calcium oxide,	1.56	2.70	–	7.66	–
Magnesium oxide,	.09	.12	–	.21	–
Potassium oxide,	1.61	.21	–	4.89	–
Sodium oxide,	2.51	.74	–	7.90	–
Phosphoric acid,	.41	.22	–	2.75	–
Nitrogen,	.70	.96	.62	1.45	.26
Insoluble matter,	.46	1.66	–	10.40	–

Sea-weed Ashes.

	Per cent.
Moisture at 100° C.,	1.47
Calcium oxide,	6.06
Magnesium oxide,	4.37
Potassium oxide,	.92
Sodium oxide,	8.76
Phosphoric acid,	.30
Sulphuric acid,	2.98
Sulphur,	.14
Chlorine,	6.60
Magnesium chloride,	.14
Insoluble matter,	63.65

Rockweed.

[I. Collected in May. II. Collected in December.]

	Per Cent.	
	I.	II.
Fresh wet rockweed lost, in air, of water,	78.700	65.920
Fresh wet rockweed lost, at 100° C., of water,	90.400	76.920
Air-dried rockweed contained, of vegetable matter,	88.220	89.000
Air-dried rockweed contained, of water,	11.780	11.000
The filled pods left, at 100° C., of solid organic matter,	7.360	–
The fresh stems left, at 100° C., of solid organic matter,	30.650	–
The slime of the pods, dried at 100° C., contained, of nitrogen,	2.920	–
Rockweed, entire plant with filled pods, dried at 100° C., contained, of nitrogen,	2.286	1.721
Rockweed, air-dried, contained, of nitrogen,	2.017	1.432
" fresh (wet), contained, of nitrogen,	.487	.397
" dried at 100° C., contained, ashes,	28.930	24.890
" air-dried, contained, ashes,	6.220	22.150
" fresh (wet), contained, ashes,	3.770	5.825
The slime of the pods contained, ashes,	49.356	–

One hundred parts of the ash contained (I.): —

	Per cent.
Potassium oxide,	4.842
Sodium oxide,	12.050
Calcium oxide,	2.691
Magnesium oxide,	2.753
Ferric oxide,	.338
Sulphuric acid,	7.986
Phosphoric acid,	6.240

Mud.

	Per Cent.					
	Mussel Mud.	Mussel Mud.	Salt Mud.	Salt Mud.	Black Mud.	Fresh-Water Mud.
Moisture at 100° C.,	60.01	2.24	46.36	60.37	56.55	40.37
Ash,	27.29	72.02	49.28	33.09	39.60	–
Calcium oxide,	.93	23.39	.90	.91	.91	1.27
Magnesium oxide,	.14	–	.31	.43	.66	.29
Potassium oxide,	6.17	–	.33	.32	.38	.22
Sodium oxide,	.70	–	.94	.94	.86	–
Ferric oxide,	3.48	8.26	4.55	3.70	4.26	1.80
Phosphoric acid,	.10	.35	Trace.	Trace.	Trace.	.26
Nitrogen,	.21	.72	.39	.40	1.64	1.37
Insoluble matter,	–	37.60	43.55	26.20	31.84	18.26

Soil from a Diked Marsh.

	Per cent.
Moisture at 100° C.,	33.40
Ash,	7.85
Calcium oxide,	1.24
Potassium oxide,	.26
Phosphoric acid,	.13
Nitrogen,	1.64
Insoluble matter,	3.65

Muck (11 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	89.89	12.03	55.13
Ash,	26.12	3.05	13.75
Nitrogen,	1.82	.26	.95

Peat (10 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	85.38	11.29*	61.50
Ash,	33.72	1.20	7.71
Calcium oxide,	–	–	.50
Nitrogen,	1.79	.41	.75
Insoluble matter,	–	–	.38

* German peat mass.

Turf (2 Analyses).

	Per Cent.	
	I.	II.
Moisture at 100° C.,	25.58	13.00
Ash,	3.28	9.43
Nitrogen,	1.91	1.97

Hen Manure.

	Per Cent.	
	Dried.	Fresh.
Moisture at 100° C.,	8.35	45.73
Calcium oxide,	2.22	.97
Magnesium oxide,	.62	–
Potassium oxide,	9.94	.18
Phosphoric acid,	2.02	.47
Nitrogen in organic matter,	1.85	.79
Nitrogen as ammoniates,	.28	
Insoluble matter,	34.65	39.32

Poudrette.

	Per cent.
Moisture at 100° C.,	5.25
Ash,	35.45
Potassium oxide,	.49
Phosphoric acid,	5.74
Nitrogen,	3.58
Insoluble matter,	4.65

Miscellaneous.

	Per Cent.	
	Soot.	Ashes from Blue Works.
Moisture at 100° C.,	5.54	12.74
Organic and volatile matter,	22.90	36.22
Magnesium oxide,	–	Trace.
Potassium oxide,	1.83	9.02
Cyanogen compounds,	–	Trace.
Insoluble matter,	35.34	12.30

COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS AND SUGAR-PRODUCING PLANTS, ETC.,

MADE AT

AMHERST, MASS.

1868–1889.

Prepared by Mr. W. H. Beal.

A. — *Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			100 Parts of Dry Matter contained — Protein.			Fat.			Nitrogen — Free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	10	29.73	11.39	20.65	17.19	8.36	11.43	3.38	1.81	2.59	63.05	42.02	55.70	27.29	20.93	24.56	5.43	1 : 7.18
Fodder corn (ensilaged),	12	28.40	13.12	20.34	12.58	6.91	8.70	6.07	3.15	3.89	65.69	42.99	56.93	35.25	17.67	25.36	5.21	1 : 9.98
Whole ears (ensilaged),	1	–	–	49.73	–	–	6.63	–	–	7.84	–	–	75.68	–	–	8.50	1.35	–
Green oats,	2	28.82	21.39	25.11	7.10	7.05	7.08	2.44	2.02	2.23	50.69	50.38	50.54	33.12	32.83	32.97	7.19	1 : 13.14
Herds-grass (timothy),	2	35.00	34.26	34.63	8.83	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.28	33.23	32.50	32.87	5.33	1 : 10.84
Hungarian grass,	1	–	–	25.93	–	–	9.38	–	–	1.61	–	–	57.80	–	–	24.67	7.15	1 : 6.86
Vetch and oats { 9 parts oats / 1 part vetch }	2	24.04	13.89	18.97	10.76	10.59	10.68	2.74	2.29	2.52	43.75	40.10	41.98	35.81	34.20	35.01	9.88	1 : 7.04
Horse bean,	1	–	–	15.17	–	–	16.68	–	–	2.31	–	–	47.09	–	–	28.17	5.75	1 : 2.71
Cow-pea,	1	–	–	19.55	–	–	17.93	–	–	2.62	–	–	46.13	–	–	25.88	7.44	1 : 11.71
White lupine,	1	–	–	14.65	–	–	18.71	–	–	2.41	–	–	42.67	–	–	31.18	5.03	–
Serradella,	1	–	–	15.40	–	–	17.75	–	–	2.65	–	–	41.54	–	–	26.21	11.85	1 : 4.07
II. Hay and Dry Coarse Fodders.																		
Fodder corn,	3	93.35	91.17	92.62	8.63	6.17	7.21	2.06	1.11	1.53	55.68	53.86	54.98	33.75	29.05	31.40	4.88	1 : 11.85
Corn stover,	6	93.05	75.00	83.73	12.15	6.47	8.21	2.63	1.27	2.09	63.05	48.82	54.65	36.10	20.93	30.41	4.66	1 : 10.43
Oats (in blossom),	1	–	–	93.57	–	–	6.58	–	–	2.92	–	–	50.03	–	–	34.06	6.41	1 : 14.23

Oats (seed in milk),	1	-	-	90.45	-	-	10.89	-	-	2.69	-	-	46.02	-	-	34.32	6.08	1:7.90
Oats (ripe),	1	-	-	91.30	-	-	6.05	-	-	2.61	-	-	48.92	-	-	36.31	6.11	1:15.03
Winter rye,	1	-	-	91.45	-	-	10.66	-	-	2.57	-	-	47.40	-	-	32.97	6.40	1:8.28
Barley (seed in milk),	1	-	-	89.75	-	-	10.26	-	-	2.76	-	-	52.91	-	-	29.12	4.95	1:9.59
Wheat straw,	1	-	-	93.80	-	-	7.20	-	-	1.63	-	-	50.46	-	-	35.91	4.80	1:8.00
Millet,	5	93.85	91.90	93.00	8.11	7.09	7.59	2.67	.89	1.74	55.80	49.62	51.63	35.91	29.80	33.54	5.49	1:7.78
English hay,	3	91.70	89.22	90.12	9.75	8.75	9.12	2.65	2.55	2.61	54.43	45.96	50.59	35.55	29.21	31.65	5.97	1:10.24
Rowen (field-cured),	2	91.16	80.29	85.73	14.70	13.20	13.95	4.96	3.05	4.01	43.79	41.92	42.86	29.46	29.43	29.45	9.75	1:6.12
Rowen, ensilaged (air-dry),	1	-	-	81.56	-	-	12.34	-	-	6.98	-	-	43.99	-	-	27.93	8.76	-
Herds-grass (timothy),	4	92.76	89.45	91.43	9.02	7.24	8.32	2.65	1.95	2.20	54.43	50.01	51.75	36.59	29.21	32.90	4.85	1:11.44
Red-top,	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.67	34.11	31.12	32.92	4.97	1:12.06
Orchard grass,	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue,	2	92.60	91.97	92.21	7.27	7.02	7.15	2.17	1.78	1.98	49.18	48.16	48.67	34.61	34.46	34.54	7.68	1:12.98
Barn-yard grass,	1	-	-	93.35	-	-	15.27	-	-	1.95	-	-	38.24	-	-	33.72	10.82	1:2.94
Hungarian grass,	1	-	-	92.55	-	-	9.45	-	-	2.22	-	-	50.64	-	-	31.96	5.73	1:6.22
White daisy,	1	-	-	90.35	-	-	7.68	-	-	2.32	-	-	46.86	-	-	36.09	7.05	-
Lucerne (alfalfa),	3	91.67	84.00	89.09	16.34	11.12	13.47	2.50	1.54	2.03	51.62	45.29	48.74	28.54	25.42	27.27	8.49	1:4.30
Sand lucerne,	1	-	-	91.20	-	-	16.26	-	-	2.59	-	-	50.31	-	-	21.27	9.57	1:3.50
Alsike clover,	2	91.70	91.36	91.53	17.32	14.97	16.15	3.26	2.89	3.08	44.94	44.63	44.79	26.28	21.44	23.86	12.14	1:4.96
Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.94	23.58	19.06	21.67	9.29	1:4.82
Serradella,	2	92.80	91.30	92.05	17.85	15.26	16.56	2.91	2.37	2.64	50.23	49.54	49.89	25.14	24.37	24.76	6.17	1:4.97
Vetch,	2	91.65	90.55	91.10	15.76	14.42	15.09	2.69	2.30	2.50	44.34	43.29	43.82	30.68	30.05	30.37	8.24	1:3.87
Horse-bean straw,	1	-	-	90.85	-	-	9.69	-	-	1.51	-	-	37.77	-	-	41.44	9.59	1:8.55

A.— *Analyses of Fodder Articles* — Concluded.

NAME.	Analyses.	Dry Matter.			100 Parts of Dry Matter contained — Protein.			Fat.			Nitrogen — Free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	4	14.51	13.05	13.92	12.17	7.82	10.47	1.76	.79	1.06	79.33	70.98	74.29	6.23	4.29	5.13	8.56	-
Beets, sugar,	6	19.53	14.01	16.48	17.44	7.32	11.63	.83	.39	.62	81.39	72.79	75.70	6.98	5.27	6.17	4.33	1:9.12
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.78	9.54	7.08	7.94	9.06	1:10.07
Ruta-bagas,	2	12.77	11.60	12.19	11.16	10.34	10.75	2.32	1.23	1.78	68.58	65.68	67.13	11.60	11.03	11.32	9.03	1:12.29
Turnips,	2	12.80	8.23	10.52	10.81	9.67	10.24	1.74	1.42	1.58	70.62	68.80	69.71	10.96	10.12	10.54	7.93	1:13.07
Carrots,	2	12.52	9.98	11.25	9.63	8.90	9.27	3.94	1.89	2.92	73.96	67.24	70.60	10.76	7.55	9.16	8.07	1:9.39
Potatoes,	9	21.95	13.91	18.78	13.56	9.58	10.48	.83	.27	.51	81.74	78.80	80.76	3.55	1.91	2.85	5.41	1:11.64
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.33	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and Other Seeds.																		
Corn kernels,	21	91.98	87.90	89.55	15.02	8.80	12.75	9.43	4.25	5.62	82.64	71.06	77.85	3.38	1.86	2.42	1.70	1:8.50
Corn kernels and cobs,	8	90.55	73.66	85.12	15.06	7.82	11.13	5.27	3.36	4.24	80.87	70.13	75.63	9.77	5.39	7.34	1.67	1:8.63
Wheat, grain,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.26	-	-	2.42	2.18	1:6.42
Broom-corn seed,	1	-	-	85.90	-	-	11.21	-	-	4.05	-	-	74.05	-	-	8.34	2.35	-
Horse beans,	1	-	-	89.72	-	-	30.03	-	-	1.11	-	-	56.48	-	-	8.11	4.27	1:2.24

V. FLOUR AND MEAL.																		
Corn meal,	17	89.29	82.96	87.14	16.08	10.07	11.30	5.74	3.10	4.46	83.21	73.20	79.87	3.92	1.56	2.73	1.65	1:8.79
Hominy meal,	3	91.89	89.30	90.75	11.88	11.20	11.61	12.22	4.89	9.33	78.07	68.00	72.27	4.78	3.69	4.08	2.71	1:8.82
Broom-corn meal,	1	-	-	86.46	-	-	11.14	-	-	4.13	-	-	74.30	-	-	8.00	2.43	-
VI. BY-PRODUCTS AND REFUSE.																		
Cotton-seed meal,	7	93.16	90.11	91.92	47.04	13.17	42.22	14.72	5.22	13.48	54.55	25.03	27.89	14.80	6.28	8.22	8.06	1:1.45
Cotton hulls,	2	89.83	88.55	89.19	5.36	4.90	5.13	4.27	2.36	3.31	46.75	33.59	42.67	51.40	40.24	45.82	3.07	-
Wheat bran,	12	90.75	86.30	89.03	20.21	15.67	17.79	6.08	2.80	4.61	62.18	56.89	59.58	14.26	7.60	11.18	6.84	1:3.78
Wheat middlings,	3	90.75	89.45	90.45	19.21	17.23	18.21	6.46	3.19	4.63	74.30	61.62	69.52	8.40	1.40	4.11	3.45	1:4.10
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.40	4.54	3.46	4.00	4.30	1:4.88
Rye middlings,	1	-	-	87.46	-	-	13.15	-	-	5.61	-	-	73.52	-	-	3.70	4.02	1:7.28
Gluten meal,	11	91.57	88.32	90.39	39.28	28.24	32.07	9.34	3.92	6.71	66.26	48.84	59.68	4.74	.27	1.16	.38	1:2.54
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.93	-	-	7.54	.90	-
Spent brewers' grain,	1	-	-	93.02	-	-	20.49	-	-	1.95	-	-	55.51	-	-	15.90	6.15	-
Linseed cake,	1	-	-	91.65	-	-	37.25	-	-	5.69	-	-	40.85	-	-	8.69	7.52	1:1.62
Pea meal,	1	-	-	91.15	-	-	20.95	-	-	1.67	-	-	55.02	-	-	19.42	2.94	1:2.07
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cocoa dust,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Apple pomace,	2	21.78	17.22	19.50	7.73	6.91	7.34	4.37	3.17	3.78	72.93	70.20	71.57	16.58	13.15	14.86	1.46	-
Apple pomace (ensilage),	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar-beet pulp,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	1:7.10
Corn cobs,	4	-	-	90.60	4.15	3.09	3.57	.67	.38	.57	63.62	60.58	61.79	33.77	31.36	32.93	1.21	1:30.85

B.—*Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

NAME.	Number of Analyses.	Moisture.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per ton of 2,000 lbs.
I. GREEN FODDERS.												
Fodder corn,	3	71.96	4.84	.52	.08	.24	.09	.03	.21	.64	.57	$3.76
Fodder corn (ensilaged),	1	71.60	–	.33	.05	.10	.09	.02	.14	.36	.04	1.68
Vetch and oats,	1	86.11	1.72	.79	.03	.09	.03	.01	.09	.23	.33	1.58
Cow-pea,	2	79.63	1.77	.45	.06	.44	.12	.01	.11	.42	.11	1.94
Serradella,	2	82.59	1.82	.42	.09	.46	.67	.02	.14	.41	.10	1.92
White lupine,	1	85.35	.74	1.73	.68	3.07	.73	.17	.35	.44	.90	3.39
Horse bean (whole plant),	1	74.71	–	1.37	.09	1.37	.62	.20	.33	.68	2.01	3.87
II. HAY AND DRY COARSE FODDER.												
Fodder corn,	5	–	4.91	.76	.10	.60	.69	.07	.51	1.80	1.65	7.38
Corn stover,	1	24.87	3.86	1.47	.79	.31	.09	.03	.20	1.00	1.32	4.89
Rowen,	1	8.84	9.57	2.86	.12	.85	.20	.06	.36	1.93	2.18	9.50
Herds-grass (timothy),	2	7.52	4.93	1.53	.22	.71	.10	–	.46	2.26	1.17	5.42
Red-top,	4	7.71	4.59	1.02	.44	.57	.13	.04	.36	1.15	1.74	5.21
Orchard grass,	4	8.84	6.42	1.88	.23	.46	.30	.03	.41	1.31	2.66	6.54

Meadow fescue,	2	7.71	7.08	2.00	.11	.50	.14	.03	.23	1.05	1.68	5.55
White daisy,	1	9.65	6.37	1.25	.16	1.30	.20	.03	.44	.28	1.11	2.54
Lucerne (alfalfa),	2	8.37	6.82	1.46	1.08	2.02	.42	.10	.45	1.76	.70	7.76
Alsike clover,	2	8.47	11.11	2.17	.40	1.74	.67	.33	.80	2.36	3.23	10.82
Serradella,	1	10.54	10.60	.26	.55	2.63	.39	–	.90	2.54	.21	11.93
Vetch and oats,	1	11.42	10.96	.50	.20	.56	.19	.08	.60	1.50	2.12	6.25
III. ROOTS, BULBS, TUBERS, ETC.												
Beets, red,	4	86.08	1.13	.45	.08	.05	.04	–	.10	.24	.03	1.32
Beets, sugar,	2	84.65	.80	.22	.15	.12	.09	.02	.08	.25	.07	1.14
Mangolds,	2	87.29	1.22	.38	.13	.06	.04	.01	.09	.19	.03	1.08
Ruta-bagas,	2	87.82	1.10	.50	.10	.09	.03	–	.13	.21	.01	1.30
Turnips,	1	87.20	1.01	.41	.13	.12	.03	.01	.12	.22	.07	1.22
Carrots,	1	90.02	–	.07	.11	.54	.02	.01	.10	.14	.01	1.06
Apples,	2	79.91	.41	.19	.03	.03	.03	–	.01	.13	–	.61
IV. GRAINS AND OTHER SEEDS.												
Corn kernels,	8	10.88	–	.44	.04	.02	.21	.01	.73	1.93	.02	7.81
Corn and cob,	4	10.00	1.45	.44	.12	.66	.16	–	.60	1.46	.09	6.05
V. FLOUR AND MEAL.												
Wheat meal,	1	9.83	1.22	.17	.11	.54	.05	–	.57	2.21	–	8.65
Hominy feed,	1	8.93	1.89	.18	–	.49	.28	–	.98	1.63	–	6.14

B. — *Analyses of Fodder Articles with Reference to Fertilizing Constituents* — Continued.

NAME.	Number of Analyses.	Moisture.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per ton of 2,000 lbs.
VI. By-Products and Refuse.												
Cotton-seed meal,	5	8.34	6.27	1.54	.17	.78	1.08	–	1.87	4.77	.58	$19.77
Cotton hulls,	3	10.13	2.61	1.08	–	.18	.26	–	.20	.75	.06	3.74
Wheat bran,	4	11.01	6.44	1.62	.18	.20	.90	.02	2.87	2.88	.13	14.61
Wheat middlings,	1	9.18	2.30	.63	.11	.20	.21	–	.95	2.63	–	10.63
Rye middlings,	1	12.54	3.52	.81	.03	.09	.32	.02	1.26	1.84	.17	8.46
Gluten meal,	3	8.75	.65	.05	.02	.03	–	.05	.40	5.21	–	18.23
Spent brewers' grain,	1	6.98	6.15	.30	.35	1.55	.29	.16	1.26	3.05	1.77	12.14
Linseed cake,	1	8.35	6.89	1.43	–	.64	.77	–	1.86	5.46	–	22.01
Pea meal,	1	8.85	–	.99	.62	.30	.30	.03	.82	3.08	.12	11.31
Broom-corn waste,	1	10.37	4.70	1.86	–	.24	.17	–	.46	.87	1.00	5.09
Cocoa dust,	1	7.10	6.35	2.11	–	.63	–	–	1.34	2.30	–	11.22
Apple pomace,	2	80.50	.27	.13	.03	.04	.03	.01	.02	.23	.01	.91

Note. — Basis of valuation, nitrogen 17 cents, phosphoric acid 6 cents, potassium oxide $4\frac{1}{4}$ cents per pound.

C. — *Analyses of Fruits.*

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Grape Sugar in Juice.	Cane Sugar in Juice.	* Soda Sol. required to neutralize 100 pts. Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), ...	Sept. 1,	20.14	1.055	12-15	3.09	-	-	-
" "	Oct. 9,	19.66	1.065	" "	6.25	-	-	-
" "	Nov. 27,	-	1.075	" "	10.42	-	-	-
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	" "	3.16	-	-	-
" " " . .	Oct. 9,	19.68	1.066	" "	7.14	-	-	-
" " " † . .	Nov. 27,	20.25	1.080	" "	11.36	-	-	-
Pear (Bartlett), ...	Aug. 31,	15.00	1.060	" "	4.77	-	-	-
" "	Sept. 7,	16.55	1.060	" "	5.68	-	-	-
" "	Sept. 20,	-	1.065	" "	8.62	-	-	-
" " ‡.	Sept. 22,	-	1.060	" "	8.93	-	-	-
Cranberries, ...		10.71	1.025	15	1.35	-	-	-§
"	1878.	10.11	1.025	15	1.70	-	-	-‖
Early York Peach (ripe), . .	-	-	1.045	25	-	1.92	6.09	45
" " " (nearly ripe),	-	10.96¶	1.039	25	-	1.36	4.12	42.3
Crawford Peach (nearly ripe),	-	-	1.050	18	-	2.19	7.02	85.6
" " (mellow), .	-	11.36¶	1.055	18	-	1.70	8.94	76
" " (not mellow),	-	11.88¶	1.045	22	-	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.

† Picked October 9.

‡ Picked September 7.

§ Free acid, 2.25 per cent.

‖ Free acid, 2.43 per cent.

¶ In pulp, kept ten days before testing.

C. — *Analyses of Fruits* — Continued.

Wild and Cultivated Grapes.

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 pts. of Juice.
	1876.			Per ct.	Per ct.	Per ct.	C. C.
Concord,	July 17,	1.0175	31	8.30	.645	7.77	–
"	July 20,	1.0150	31	8.10	.625	7.72	216
"	Aug. 2,	1.0200	25	9.94	.938	9.44	249
"	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
"	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
"	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
"	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Purple Wild Grape,	July 19,	1.020	31	9.00	.714	7.93	204
" " "	Aug. 4,	1.020	28	12.25	1.100	8.98	249
" " "	Aug. 16,	1.025	28	12.48	2.000	16.03	233
" " "	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape,	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific,	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' Seedling,	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona,	Sept. 7,	1.080	21	24.56	15.15	61.68	144
" (mildewed),	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam,	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder,	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware,	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak,	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella,	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling,	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack,	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba,	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder,	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak,	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord,	Sept. 13,	1.065	24	15.90	13.16	82.76	102
"	Sept. 26,	1.075	21	19.34	15.43	79.78	70.8
Eumalan,	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape,	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
" " " (shrivelled),	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled),	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure Na_2CO_3 in 100 parts water.

C. — *Analyses of Fruits* — Continued.

Effect of Girdling on Grapes.

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 parts of Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled,	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
" " girdled,	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled,	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
" girdled,	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled,	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
" girdled,	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled,	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
" girdled,	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled,	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
" girdled,	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled,	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
" girdled,	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
" not girdled,	Sept. 26,	1.065	22	17.63	13.70	78.27	86
" girdled,	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
" not girdled,	Oct. 5,	1.075	12	20.92	17.50	85.37	42
" girdled,	Oct. 5,	1.085	12	–	17.86	–	54

* One part of Na_2CO_3 in 100 parts of water.

C. — *Analyses of Fruits* — Continued.

Effect of Fertilization upon the Organic Constituents of Wild Grapes.

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per cent. of Grape Sugar.	Per cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	–	–	8.03	–	Unfertilized.
" " " " . .	"	19.55	–	–	13.51	–	Fertilized.
" " " Juice, . .	"	–	1.045	16	8.22	9.840	Unfertilized.
" " " " . .	"	–	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries. .	"	20.02	–	–	–	–	Unfertilized.
" " " " . .	"	21.65	–	–	–	–	Fertilized.
" " " Juice, . .	"	–	1.060	16	10.00	1.846	Unfertilized.
" " " " . .	"	–	–	–	14.29	.923	Fertilized.

Effect of Fertilization upon the Ash Constituents of Grapes.

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
" " "	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized
" " .	July 17,	47.34	1.13	24.21	–	.75	21.38	.43	"
" " .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	"
" " .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	"
	1878.								
" " .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. — *Analyses of Fruits* — Concluded.

Ash Analyses of Fruits and Garden Crops.

	Ash.	100 Parts of Ash contained—						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord grape (fruit),	-	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	-	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	-	40.69	-	6.85	6.24	-	9.04	-
Skins and pulp,	-	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	-	-	3.03	-	17.20	.29
Stems of grapes,	4.69	20.91	-	20.20	8.45	-	17.75	2.09
Young branches,*	-	24.71	.94	40.53	10.66	1.03	17.16	4.92
Wood of vine,†	2.97	22.57	-	9.72	4.28	-	14.07	23.84
Clinton grape (fruit),	-	58.45	3.51	13.34	7.37	.90	18.19	-
Baldwin apple,	-	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit),‡	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.36
" " §	-	58.47	-	14.64	6.12	3.37	17.40	-
" vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.[illegible]7
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	-	14.27	-
" vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	-
" white,	.59	52.79	3.00	17.08	5.68	2.67	15.78	-
Crawford peach, sound,	-	74.46	-	2.64	6.29	.58	16.02	-
" " diseased,‖	-	71.30	-	4.68	5.49	.46	18.07	-
Branch, sound,	-	26.01	-	54.52	7.58	.52	11.37	-
" diseased,‖	-	15.67	-	64.23	10.28	1.45	8.37	-
Asparagus stems,	-	42.94	3.58	27.18	12.77	1.22	12.31	.08
" roots,	-	56.43	5.42	15.48	7.57	-	15.09	3.67
Onions,	-	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms. † One year old. ‡ Wilder. § Downing. ‖ Yellows.

D. — *Analyses of Sugar-producing Plants.*

Composition of Sugar Beets raised upon the college grounds during the season of 1870 and 1871.

NAME.	Date.	Brix Saccharometer (Degrees).	Per cent. of Sugar.	Non-saccharine Substances.
Electoral,	Sept. 10,	14	12.30	1.75
Imperial,	" 12,	15	12.59	2.41
Vilmorin,	" 13,	14.5	12.95	1.55
Imperial,	" 18,	14	10.79	3.21
Imperial,	Oct. 11,	15	12.05	2.95
Electoral,	" 16,	15	12.22	2.78
Vilmorin,	" 18,	16	13.13	2.87
Imperial,	Nov. 14,	15	11.60	3.34
Vilmorin,	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,*	" 19,	9	5.00	3.97

* Fodder beets.

Percentage of Sugar in Different Varieties of Sugar Beets grown on college farm during the season of 1882.

NAME.	Source of Seed.	Weight in Pounds.	Per cent. of Sugar in Juice.
I. Vilmorin,	Saxony,	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. "	"	$\frac{3}{4}$ to 1	15.61
I. White Imperial,	"	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
II. " "	"	$1\frac{3}{4}$ to 2	10.27
New Imperial,	"	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg,	"	$1\frac{1}{2}$ to 2	13.10
II. " "	Silesia,	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg,	Saxony,	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian,	Silesia,	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

D. — *Analyses of Sugar-producing Plants* — Continued.

Effect of Soil and Fertilization on Electoral Sugar Beets. *

Soil.	Manure.	Specific Gravity Brix (Degrees).	Per cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	" " " .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard manure and chemicals, . . .	12.75	9.17	3.58	71.92
" " .	Fresh hog manure, .	13.5	9.53	3.97	70.06
Light sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm.

Effect of Fertilization on Sugar Beets.*

Fertilizers.	Percentages of Sugar in Juice.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, . .	12.55	13.24	10.50
Kainite and superphosphates, . .	13.15	12.16	10.50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam.

D. — *Analyses of Sugar-producing Plants* — Continued.

Effect of Different Modes of Cultivation on Electoral Sugar Beets.

LOCALITY OF BEET-FIELD.	Brix Saccharometer (Degrees).	Per cent. of Cane Sugar.	Non-saccharine Substances.
Sing Sing, N. Y.,	11	7.80	3.20
Washington, N. Y.,	14	10.97	3.03
South Hartford, N. Y.,	15	11.70	3.30
Greenwich, N. Y.,	12	9.50	2.50
Frankfort, N. Y.,	13.5	11.00	2.50
Albion, N. Y.,*	18	15.10	2.90
" " †	14	9.70	4.30

* From beets weighing from 1½ to 2 lbs. † From beets weighing from 10 to 12 lbs.

D.— *Analyses of Sugar-producing Plants* — Continued.

Early Amber Cane.

Date.	Condition of Cane.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Grape Sugar.	Cane Sugar.	Soda Sol. required to neutralize 100 pts. of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15, .	No flower stalks in sight,*	4.2	27	2.48	None	6.8	7.93
Aug. 16, .	" " " " *	5.8	24	4.06	None	9.0	11.10
Aug. 20, .	Flower stalks developed,*	7.9	24	3.47	2.15	7.0	13.00
Aug. 24, .	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27, .	Plants in full bloom,*	10.0	25	3.65	4.13	10.0	15.48
Aug. 30, .	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2, .	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.35
Sept. 9, .	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9, .	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18, .	Left on field without stripping,* . .	13.2	22	3.57	7.65	-	-
Sept. 18, .	Tops removed,*	13.8	22	3.16	8.49	-	-
Sept. 18, .	Tops and leaves removed on Sept. 9,* .	11.5	22	3.16	5.85	-	-
Sept. 18, .	Tops removed; left on field 9 days,* .	12.8	22	10.00	.60	-	-
Sept. 21, .	Juice from the above,*	13.0	21	-	-	-	-
Sept. 23, .	" " " *	15.0	18	-	-	-	-
Sept. 25, .	Left on field 3 weeks,†	19.8	21	11.91	6.27	-	-
Sept. 28, .	" " " †	17.8	12	16.60	-	-	-
Oct. 4, .	" " " †	16.1	17	8.62	6.16	12.0	-
Oct. 7, .	Freshly cut. Ground with leaves,† .	16.7	20	4.16	9.94	6.8	-
Oct. 8, .	" " Stripped 2 weeks,† . .	12.8	17	5.16	5.27	7.0	-
Oct. 9, .	" " " " † . .	18.4	17	7.57	-	10.6	-
Oct. 14, .	Several weeks old,†	18.2	15	10.42	-	10.4	-
Oct. 18, .	" " " †	15.1	23	7.57	-	-	-
Oct. 19, .	" " " †	15.5	15	9.22	-	13.6	-
Oct. 22, .	" " " †	16.2	16	8.30	-	-	-
Oct. 23, .	" " " †	18.3	17	11.30	5.5	14.0	-
Oct. 24, .	" " " †	16.6	15	8.63	-	9.0	-

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D.—*Analyses of Sugar-producing Plants*—Concluded.

Composition of the Juice of Corn Stalks and Melons.

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Grape Sugar in Juice.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn, *	1.023	27	4.35	.28	15.18
Black Mexican sweet corn, †	1.048	27	2.06	7.02	17.44
Evergreen sweet corn, †	1.052	–	4 85	5.70	20.38
Common sweet corn, ‡	1.035	–	6.60	None.	–
Common yellow musk-melon, §	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
" "	1.025	19	3 84	1.77	–
Nutmeg musk-melon, ‖	1.030	19	3.33	2.11	–
" " ¶	1.050	20	2.27	5.38	–
" " **	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

Dairy Products.

NAME.	Volatile Matter and Moisture at 100° C.	Ash.	Fat.	Casein.	Non-nitrogenous Extract.
Whole milk, ...	87.40	.70	4.00	3.20	4.70
Skim milk,.	89.81	.80	.37	3.53	5.49
Buttermilk, ...	91.84	.80	.21	2.79	4.36
Whole milk cheese (Jersey),* .	37.16	3.39	37.32	22.13	-
Whole milk cheese,* . . .	35.83	3.14	34 34	26.69	-
Cheese from milk skimmed after 12 hours' standing,* . .	37.30	4.52	27.81	30.37	-
Cheese from milk skimmed after 24 hours' standing,* . .	42.24	2.35	23.42	31.99	-
Cheese from milk skimmed after 36 hours' standing,* . .	43.95	5.14	17.67	33.24	-
Cheese from milk skimmed after 48 hours' standing,* . .	45.41	3.88	15.77	34.94	-
Cheese from skim milk with addition of buttermilk,* . .	48.38	4.64	18.35	28.63	-
Genuine oleomargarine cheese,*	37.90	4.50	31.66	25.94	-

* From analyses made in 1875.

METEOROLOGY.

The meteorological observations of the past year have been a continuation of those of preceding years, being on the same general plan as recommended to voluntary observers of the United States Signal Service. Observations are made at 7 A.M., 2 P.M. and 9 P.M., and include observations of temperature, quantity and movements of the clouds, direction of the wind, the humidity of the air during the summer months, rain and snow fall, and of casual phenomena.

January opened with 4 inches of snow and good sleighing, which continued through the larger part of the month. On the 26th, a heavy snow-storm. At the close of the month the snow averaged about 18 inches. Quite a depth of snow remained on the ground until the thaw of the 20th of February. The snowfall for the month of February amounted to 9.5 inches. At the close of the month there were 6 inches on the ground.

From the 11th to the 16th of March occurred the severest storm of the season. This storm is recorded as giving 16 inches of snow, which amounted to 3.35 inches of water. The storm was accompanied by high winds. The comparatively warm weather which followed took the snow off rapidly. At the close of the month there were but 2 inches of snow on the ground. The last storm of the season occurred on April 10, with a record of 1.5 inches of snowfall.

The rainfall for the year amounted to 58.04 inches, or an average of 4.84 per month. According to the observations at Amherst, this is the heaviest since they were begun in 1836.

The average rainfall for the years 1836–1888 amounts to 44.34 inches. The smallest rainfall during this time was in

1864, 34.44 inches; this was preceded, however, by a rainfall of 56.19 inches in 1863, which is, next to 1888, the highest for the period.

The largest rainfall during any one month was 10.70 inches in September. This record for one month has been exceeded only five times during the period covered by the Amherst observations (1836–1889). The rainfall was pretty evenly distributed throughout the rest of the year.

The mean annual temperature for the year is 43.98°. The average for the period from 1837–88 is 46.81. The average for the year 1875 was 44.22, which is the lowest except for the year 1888. The highest average thus far for any year has been 49.47°, in 1878. January, 1888, was the coldest month since 1837, being 9.5 lower than the average for that period. The temperature for October has been lower but once, — 1841, — and for April and July but twice, since the records began. The temperature for June, August and November was the average for those months, while December shows a considerably higher mean. February, March, May and September were considerably below the average. The weather during the growing months was quite favorable to the grass crop, but corn suffered considerably from the wet weather. The latter was unfavorable for the curing of both these crops.

The last killing frost of the season occurred May 8; the first in the autumn, September 7. The average date of the first killing frost in this vicinity is September 20. Light frost occurred May 16 and September 6. Snow-squalls occurred October 9; the first snow-storm happened November 25. This snowfall, amounting to 5 inches, was the only appreciable one during the month. The snow disappeared quickly. In December there were two slight storms, amounting to less than 3 inches.

The prevailing direction of the wind for the year was N. W. It was north-west in January, February, March, April, June, July, August, September, October and December; south-west in May, and north-east in November.

The number of days when the sky was less than four-tenths covered by clouds, clear days, was 58; the greatest number, 9, being in January, and the fewest, 1, in August.

There were 97 "cloudy" days, or those when the sky was more than seven-tenths covered by clouds. March and October had 12 cloudy days each; April and July the fewest, 3 each. The remaining days were variable, being partly cloudy and partly fair.

The highest temperature of the year was 94.5°, occurring July 23; the lowest, —21.5°, occurring January 23. The maximum for the previous year, 1887, was 93.6°, on the 2d of July, and the minimum was —22.2°, on the 19th of January. The absolute range of temperature for 1888 was 116°, practically the same as for 1887, 1° less than for 1886.

Summary of Meteorological Observations, 1888.

	Temperature. Degrees Fahrenheit.											Relative Humidity. Per ct.				Precipitation. Inches.	
	7 A.M.	2 P.M.	9 P.M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A.M.	2 P.M.	9 P.M.	Mean.	Depth of Water.	Date of Greatest Fall.
January, . .	11.0	18.6	12.9	13.78	28.9	—3.5	32.4	41.0	2d	—21.5	23d	-	-	-	-	3.87	1st
February, . .	16.1	28.7	22.1	22.05	36 9	.3	36.6	49.0	14th	—19.0	10th	-	-	-	-	3.94	20th
March, . . .	22.2	32.5	26.3	26.82	41.9	18.8	23.1	49.0	21st	—3.0	19th	-	-	-	-	5.96	11th to 14th
April, . . .	35.8	49.2	39.5	40.44	67.3	28.3	39.0	81.0	29th	15.0	9th	-	-	-	-	3.08	5th
May, . . .	49.6	62.7	53.2	54.70	68.0	39.7	28.3	80.0	29th	26.0	3d	82.7	61 3	79.3	74.4	4.29	11th
June, . . .	61.5	74.1	63.6	65.82	79.2	56.4	22.8	94.5	23d	38.0	2d	81.4	60.4	77.7	73.1	5.40	23d
July, . . .	61.6	76.5	65.5	67.20	73.4	60.2	13.2	85.5	5th	46.0	14th, 18th	82.9	53.1	78.6	71.5	3.63	19th to 20th
August, . . .	63.1	75.4	65.5	67.38	78.6	57.0	21.6	87.0	16th	42.0	23d	85 5	61.5	83.0	76.7	4.29	12th to 13th
September, . .	52.6	65.1	56.0	57.10	70.9	36.9	34.0	76.0	2d, 17th	25.0	30th	93.3	63.0	86.5	80.9	10.70	20th to 21st
October, . .	38.7	49.2	42.1	43.12	56.0	35.1	20.9	66.0	5th	26.0	11th	89.0	65.2	82.1	78.1	5.19	6th to 7th
November, . .	35.2	47.9	38.0	38.93	59.6	13.9	45.7	71.0	2d	5.7	23d	-	-	-	-	3.91	8th to 10th
December, . .	26.4	35 4	29.9	30.40	49 4	9.4	40.0	56.5	25th	3.5	14th	-	-	-	-	3 78	16th to 18th
Sums, . .	473.8	615.3	514.6	527.74	710.1	352.5	357.6	839 5	-	188.7	-	514.8	364.5	487.2	454.7	58.04	-
Means, . .	39.5	51.3	42.9	43.98	59.2	29.4	29.8	70.0	-	15.7	-	85.8	60.8	81.2	72.5	4.84	-

Miscellaneous Phenomena—Dates.

	Frost.	Snow.	Rain.	Thunder storms.	Lunar Halos.
January, ...	–	4, 8, 10, 13, 17, 25, 26,	1, 15,	–	–
February, ...	–	4, 7, 10, 11, 18, 25,	4, 8, 20, 25,	–	24
March, ...	–	2, 11, 12, 13, 21, 26,	20, 21, 22, 26, 27, 28,	–	25
April, ...	4, 17, 23, 24, 25,	10,	1, 2, 5, 10, 12, 14, 18, 20,	5,	–
May, ...	3, 8, 16,	–	1, 5, 8, 10, 11, 12, 13, 14, 15, 16, 18, 28, 29,	14,	21
June, ...	–	–	6, 7, 14, 15, 20, 21, 23, 24, 26, 28, 30,	6, 14, 15, 21, 23, 24, 30	–
July, ...	–	–	1, 5, 9, 11, 19, 20, 27, 31,	1, 5, 11,	–
August, ...	–	–	4, 5, 6, 12, 13, 17, 21, 22,	4, 17,	18
September, ...	6, 7, 29, 30,	–	1, 8, 12, 16, 17, 18, 20, 21, 26,	20, 21,	15
October, ...	1, 3, 4, 11, 15, 19, 22, 26, 30,	–	1, 2, 6, 7, 12, 13, 14, 16, 17, 19, 24, 27, 28,	–	–
November, ...	13, 17, 21, 22, 23, 24,	25,	3, 8, 9, 10, 15, 16, 19, 26, 27, 29,	–	14
December, ...	3, 7, 21, 22,	4, 9,	6, 11, 16, 17, 18, 27,	–	15

RECORD

Of the Average Temperature taken from Weather Records at Amherst, Mass., for three consecutive months, during the summer and winter beginning with the year 1836.

December, January, February.	Degrees F.	June, July, August.	Degrees F.
1836–37, . .	25.396	1837, . . .	69.130
1837–38, . .	26.386	1838, . . .	69.550
1838–39, . .	25.950	1839, . . .	70.180
1839–40, . .	20.626	1840, . . .	68.770
1840–41, . .	23.146	1841, . . .	69.230
1841–42, . .	28.516	1842, . . .	68.210
1842–43, . .	23.460	1843, . . .	67.950
1843–44, . .	21.320	1844, . . .	67.260
1844–45, . .	25.550	1845, . . .	70.120
1845–46, . .	22.140	1846, . . .	68.406
1846–47, . .	25.176	1847, . . .	68.806
1847–48, . .	28.966	1848, . . .	69.210
1848–49, . .	23.026	1849, . . .	69.210
1849–50, . .	27.570	1850, . . .	68.820
1850–51, . .	25.040	1851, . . .	66.640
1851–52, . .	21.620	1852, . . .	66.830
1852–53, . .	27.940	1853, . . .	67.846
1853–54, . .	23.670	1854, . . .	69.856
1854–55, . .	23.126	1855, . . .	67.146
1855–56, . .	20.820	1856, . . .	69.225
1856–57, . .	22.720	1857, . . .	67.240
1857–58, . .	26.956	1858, . . .	67.930
1858–59, . .	24.746	1859, . . .	65.650
1859–60, . .	24.790	1860, . . .	66.540
1860–61, . .	24.510	1861, . . .	66.870
1861–62, . .	24.470	1862, . . .	66.490
1862–63, . .	27.640	1863, . . .	66.656
1863–64, . .	26.060	1864, . . .	69.336
1864–65, . .	21.310	1865, . . .	68.946
1865–66, . .	25.676	1866, . . .	67.400
1866–67, . .	25.276	1867, . . .	67.920

Record of Temperature, etc.—Concluded.

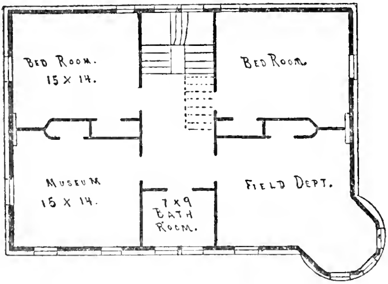
December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1867–68, . .	20.350	1868, . . .	69.700
1868–69, . .	26.290	1869, . . .	66.890
1869–70, . .	27.866	1870, . . .	71.700
1870–71, . .	26.666	1871, . . .	67.810
1871–72, . .	24.630	1872, . . .	70.790
1872–73, . .	21.350	1873, . . .	68.596
1873–74, . .	27.286	1874, . . .	66.306
1874–75, . .	21.180	1875, . . .	68.026
1875–76, . .	28.156	1876, . . .	71.780
1876–77, . .	23.510	1877, . . .	70.080
1877–78, . .	28.506	1878, . . .	68.896
1878–79, . .	24.290	1879, . . .	68.150
1879–80, . .	30.506	1880, . . .	69.286
1880–81, . .	21.856	1881, . . .	67.966
1881–82, . .	29.256	1882, . . .	69.866
1882–83, . .	24.220	1883, . . .	68.840
1883–84, . .	26.506	1884, . . .	68.960
1884–85, . .	22.630	1885, . . .	66.740
1885–86, . .	24.846	1886, . . .	66.100
1886–87, . .	22.146	1887, . . .	68.100
1887–88, . .	20.827	1888, . . .	67.893

JAMES P. LYNDE, *Treasurer, in Account with the* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

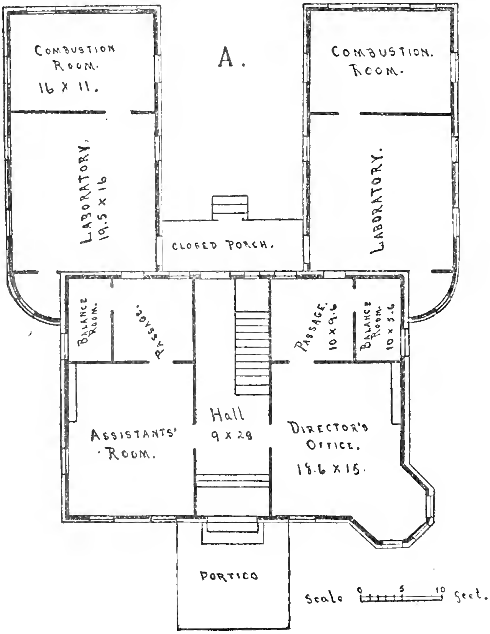
1888.		Received.		1888.	Expended.	
Jan.	1,	Cash balance in bank,	$263.11		Salaries,	$3,873.76
	4,	State Treasurer,	2,500.00		Laboratory supplies,	747.61
	11,	Dr. C. A. Goessmann, Director,	222.46		Printing and postage,	641.00
	11,	Dr. C. A. Goessmann, Director,	176.27		Office expenses,	287.33
April	2,	State Treasurer,	2,500.00		Farmer and farm labor,	1,813.73
June	19,	Dr. C. A. Goessmann, Director,	99.62		Farm supplies,	533.34
July	5,	State Treasurer,	2,500.00		Stock,	95.00
Sept.	28,	State Treasurer,	2,500.00		Feed,	281.55
Oct.	13,	Dr. C. A. Goessmann, Director,	162 00		Miscellaneous expenses,	491.83
Nov.	6,	Dr. C. A. Goessmann, Director,	200.00		Construction and repairs,	2,935.84
Dec.	3,	Dr. C. A. Goessmann, Director,	10 00		Expenses Board of Control,	137.80
	22,	Transferred from Hatch Funds,	705.33			
			$11,838.79			$11,838.79

Examined, compared with the vouchers, found correct, and approved. WM. R. SESSIONS, *Auditor*.

B.



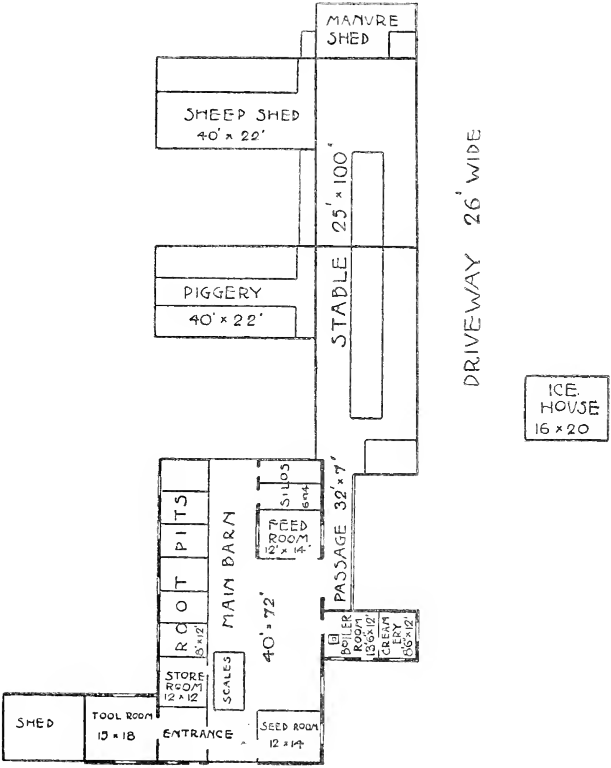
STATION BUILDING – 2nd FLOOR.



STATION BUILDING – GROUND PLAN.

A. Laboratory Building........ Ground Plan

B " " Second Floor



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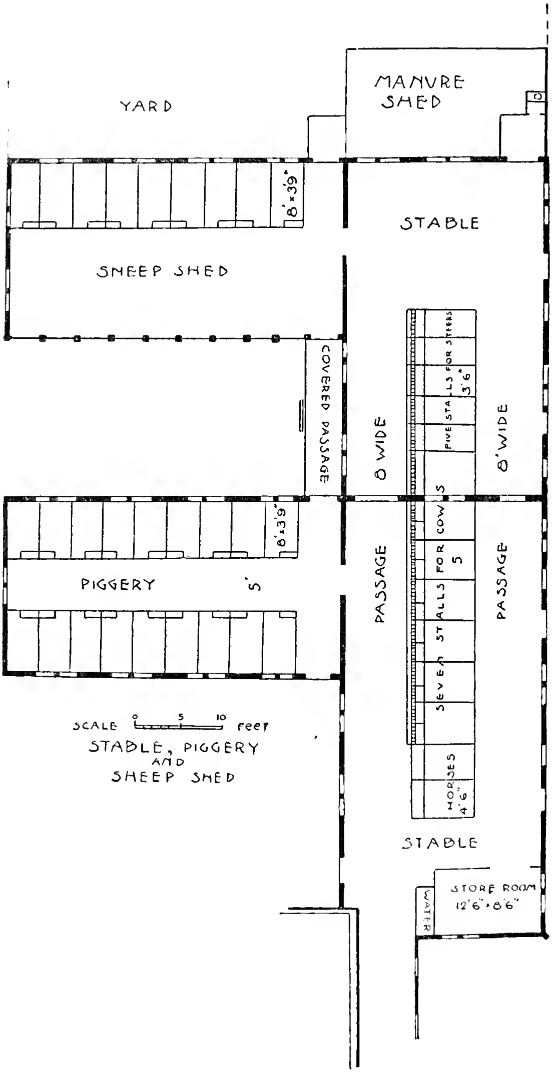
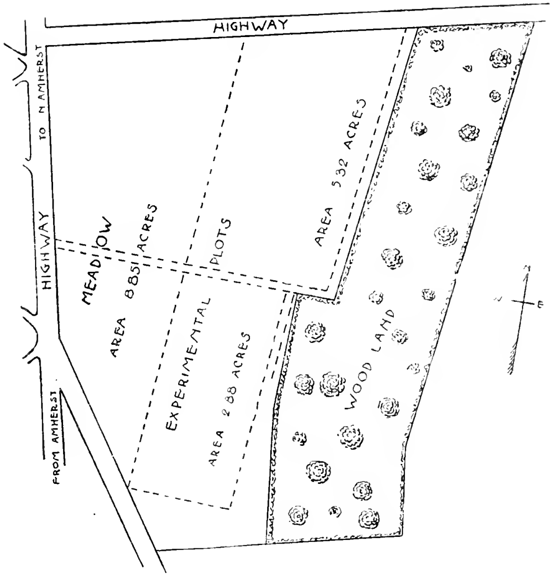
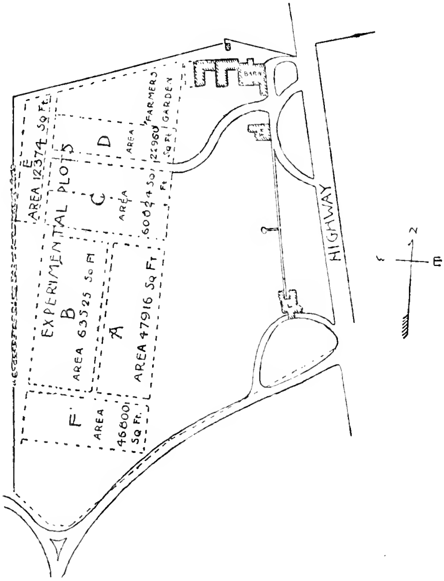
PLAN OF FARM BUILDINGS.



STABLE, PIGGERY AND SHEEP SHED



MAP·OF·LAND·LEASED·TO·THE
·MASSACHUSETTS·EXPERIMENT·STATION·
·FROM·THE·
·AGRICULTURAL·COLLEGE·FARM·
·EAST OF THE·HIGHWAY
·AREA·TAKEN 3052 ACRES



MAP·OF·LAND·LEASED·TO THE
·MASSACHUSETTS·EXPERIMENT·STATION·
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·AGRICULTURAL·COLLEGE·FARM
WEST·OF·THE HIGHWAY·
·AREA·TAKEN 1772 ACRES·

INDEX TO SECRETARY'S REPORT.

APPENDIX.